IS 10000-4 (1980): Methods of Tests for Internal Combustion Engines, Part IV: Declaration of Power, Efficiency, Fuel Consumption and Lubricating Oil Consumption [TED 2: Automotive Primemovers]

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Indian Standard

(Reaffirmed 2001)

METHODS OF TESTS FOR INTERNAL COMBUSTION ENGINES

PART IV DECLARATION OF POWER, EFFICIENCY, FUEL CONSUMPTION AND LUBRICATING OIL CONSUMPTION

1. Scope — Lays down the guidelines for declaring power, efficiency, fuel consumption, lubricating oil consumption and specifies the relevant correction factors which are required for adjusting the observed readings to the standard reference conditions, as specified in IS : 10000 (Part II) - 1980 'Methods of tests for internal combustion engines : Part II Standard reference conditions', for variable speed and constant speed engines.

SECTION I CONSTANT SPEED ENGINES

2. Declaration of Rated Power Output and Speed

2.1 Statements of power are required for two main purposes:

a) The declaration by a manufacturer of value of the power which the engine will deliver under standard reference conditions. This declared value is known as the 'Rated Power', and

b) The verification by measurement that the engine delivers the power which has been declared in 2.1(a), under the same set of reference conditions or after proper allowance has been made for any difference in ambient site conditions from the standard reference conditions.

2.2 *IS Rating* — IS Rating of the engine shall be of two types:

2.2.1 *IS Rating A (with overload)* — The net output in brake power which the engine is capable of delivering continuously, at the rated crankshaft speed (in rev/min) under the operating conditions of the manufacturer's test bed and adjusted to standard reference conditions specified in Section I of IS : 10000 (Part II)-1980. The engine shall be capable of delivering an output of 10 percent in excess of its rated output at its rated speed for a period of 1 hour in any period of 12 hours continuous running, without undue heating of the engine or any other mechanical trouble.

Note — The 10 percent excess output shall be considered an overload condition. It may be used on engines where fuel stop is set to this condition at the discretion of the purchaser but it should be clearly understood that the frequent use of this overload will increase maintenance and reduce periods between overhauls.

2.2.2 *IS Rating B (without overload)* — The net output in brake power which the engine is capable of delivering continuously, at rated crankshaft speed (in rev/min) under the operating conditions of the manufacturer's test bed and adjusted to the standard reference conditions specified in Section I of IS : 10000 (Part II)-1980. The engine shall be able to give its rated output for 12 h continuous running without undue heating or any other mechanical trouble.

Note — For the same engine IS Rating B will be higher than IS Rating A.

2.3 *Power Adjustment Factor* 'α' — Is the ratio of power output under the ambient site conditions to the power output under standard reference conditions.

$$P_x = \alpha . P_r, \text{ and} \quad \ldots \quad \ldots (1)$$

$$\alpha = k - 0{\cdot}7 (1 - k) \left(\frac{1}{\eta_m} - 1 \right) (\textit{see} \text{ Note 2}) \quad \ldots (2)$$

$$k = \left(\frac{p_x - a . \phi_x . p_{sx}}{p_r - a . \phi_r . p_{sr}} \right)^m \times \left(\frac{T_r}{T_x} \right)^n \quad \ldots \quad \ldots (3)$$

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where

P = brake power, in kW;
a = power adjustment factor;
k = ratio of indicated power;
p = barometric pressure, kPa;
p_s = saturation vapour pressure, kPa;
ϕ = relative humidity;
T = absolute air intake temperature, K; and
η_m = mechanical efficiency.

Note 1 — For using these formulae, reference shall be made to Table 1 and appendices.

Note 2 — When the ambient conditions are more favourable than the standard reference conditions, the declared power under the ambient site conditions may be limited by the manufacturer to the declared power at the standard reference conditions as specified in Section 1 of IS : 10000 (Part II)-1980.

Note 3 — The values of mechanical efficiency shall be stated by the manufacturer. In the absence of any such statement, the value of η_m=0·90 will be assumed. Alternatively, measured value may be used (*see* 8).

Note 4 — Subscript 'r' corresponds to values under the standard reference conditions.

Note 5 — Subscript 'x' corresponds to values under the ambient site conditions.

Note 6 — The factor 'a' and exponents 'm' and 'n' have numerical values as given in Table 1.

Note 7 — k is also called 'Ratio of Indicated Power' and expression $\frac{p_x - a.\phi_x.p_{sx}}{p_r - a.\phi_r.p_{sr}}$ is called 'Dry Air Pressure Ratio'.

TABLE 1 NUMERICAL VALUES OF POWER ADJUSTMENT FACTORS AND EXPONENTS

(*Clauses* 2.3, 2.3.1, 3.2.2 *and* B-3)

Engine Type	Condition		Formula Reference (*see* Appendix G)	Factor	Exponents	
				a	m	n
Compression ignition oil engines and dual fuel engines	Non-turbo charged	Power limited by air excess	A	1	1	0·75
		Power limited by thermal reasons	B	0	1	1
Spark ignition engines using gaseous fuel	Non-turbo charged		E	1	0·86	0·55
Spark ignition engines using liquid fuel	Naturally aspirated		G	1	1	0·5

Note — The factors and exponents given in Table 1 have been established by tests on a number of engines to be generally representative and shall be used in absence of any other specific information. At present they apply only to the types of engines specified. Table 1 will be extended to include other types when sufficient data are available.

2.3.1 The power adjustment factor 'α' can be calculated using Appendices A, B, C and D. Tabulated values of 'α' for 60, 80 and 100 percent relative humidity for various efficiencies are given in Appendix E for guidance. Power adjustment factors can also be obtained using the nomograms in Appendix G. Example of calculation of power adjustment is given in Appendix H. Nomograms in Appendix G also show the examples of power adjustment using factors and exponents in Table 1. Fig. 1 gives flow chart of calculation of 'α' using Appendices A, B, C, D and F and Table 1.

2.3.2 In deriving this factor, following assumptions have been made:

a) The air fuel ratios are the same in both cases for equivalent engine performance,

b) The indicated thermal efficiencies are the same, and

c) The frictional losses are also the same.

3. Declaration of Fuel Consumption — The engine manufacturer shall state the specific fuel consumption at rated output under the standard reference conditions specified in Section 1 of IS : 10000 (Part II)-1980 for engines of all ratings. In addition for all engines above 20 kW, specific fuel consumption shall also be declared at 110, 75, 50 and 25 percent of rated load.

3.1 A tolerance of ±5 percent in fuel consumption at 100 percent of the rated load shall be allowed unless otherwise agreed to between the manufacturer and the purchaser.

3.2 Specific fuel consumption at the ambient site conditions shall be corrected to the standard reference conditons specified in Section 1 of IS : 10000 (Part II)-1980 using specific fuel consumption adjustment factor 'β' given below.

3.2.1 *Specific fuel consumption adjustment factor* 'β' — It is the ratio of the specific fuel consumption under site conditions to the specific fuel consumption under standard reference conditions, that is,

$$\beta = \frac{\text{Specific fuel consumption under ambient site conditions}}{\text{Specific fuel consumption under standard reference conditions}}$$

also,

$$\beta = \frac{k}{\alpha}$$

where

k and α have same connotation as in **2.3.**

Note — In deriving this factor, the assumptions made in **2.3.2** are valid.

3.2.2 The values of specific fuel consumption adjustment factor 'β' can be determined by using data in Appendix F. Example of calculation of specific consumption adjustment is given in Appendix H. Nomograms in Appendix G also show the example of obtaining specific fuel consumption adjustment using factors and exponents in Table 1. Fig. 1 gives flow chart for calculation of 'β' using Appendices B, C, D and F and Table 1.

3.2.3 *Adjustment for calorific value of fuel for liquid fuel engines* — In case the liquid fuel engines use fuel different from the fuel with a lower calorific value of 42 000 kJ/kg, a correction for the difference in calorific value given by the following formula shall also be applied:

$$\beta_{cv} = \frac{g_{fx} \times CV}{42\,000 \times P_x}$$

where

β_{cv} = specific fuel consumption adjustment factor for calorific value of fuel;
g_{fx} = adjusted specific fuel consumption, g/kWh (obtained under **3.2**);
CV = net calorific value of fuel, kJ/kg; and
P_x = adjusted brake power (*see* **2.3**).

Note — The specific fuel consumption of a liquid fuel engine is related to a reference lower calorific value of 42 000 kJ/kg.

4. Declaration of Lubricating Oil Consumption

4.1 *Lubricating Oil Consumption* — It is the quantity of lubricating oil consumed by an engine per unit of time. It should be expressed in litres or kg per engine operating hour as appropriate to the particular engine application. The lubricating oil consumption may be determined after the 12 hour rating test at 100 percent load.

4.2 Lubricating oil consumption shall be determined on a well run-in engine. The period of running and duration of the test for lubricating oil shall be declared by the manufacturer. The lubricating oil consumption shall be measured by the drain plug method or any other method acceptable to the inspecting authority.

5. Overload Capacity — The engine shall be capable of delivering an output 10 percent in excess of IS Rating A (*see* 2.2.1) for a period of one hour in any period of 12 hours continuous running, without undue heating of the engine or any other mechanical trouble.

Note 1 — It should be clearly understood that the frequent use of this overload will increase maintenance and reduce periods between overhauls.

Note 2 — During the overload test a speed drop of up to 1 percent below the rated speed shall be allowed for engines with Class A governing. The governor shall not be reset for this condition.

Note 3 — During the overload test for small engines up to 7·8 kW rated power with Class B1 or Class B2 governing, a speed drop up to 1 percent below the rated speed shall be allowed. If the speed drops by more than 1 percent, the governor may be allowed to be adjusted.

6. Mechanical Efficiency — Shall be declared by the engine manufacturer and shall be measured preferably by hot motoring method laid down in 6.1. Alternatively, it may be calculated by using the indicated power from the indicator diagram.

6.1 *Hot Motoring for Measurement of Mechanical Efficiency* — The engine shall be run under 100 percent load so that it attains stable thermal conditions. The engine shall be deemed to have attained stable thermal conditions when the temperature of the coolant at outlet remains stable within 5 K. While measuring the mechanical efficiency, the ignition [spark plugs in case of spark ignition engines and fuel delivery in case of compression ignition (diesel) engines] shall be instantly switched off or closed. The electric brake (dynamometer) operates as a motor and the torque spent by the motor to rotate the engine shaft is measured.

SECTION II VARIABLE SPEED ENGINES

7. Declaration of Power — The declarations of power are required for two main purposes as follows:

a) Declaration by a manufacturer of value of the power which the engine will deliver under standard reference conditions. This declared value is known as the ' rated power '. The rated power shall correspond to IS rating as defined in 7.2.

b) Verification by measurement that the engine delivers the power which has been declared in 7(a) under the same set of reference conditions or after proper allowance has been made for any difference in the ambient site conditions from the standard reference conditions.

7.1 The declaration of the engine output shall be presented by the manufacturer in the form of performance curves at different operating speeds at full throttle obtained under the reference conditions given in Section II of IS : 10000 (Part II)-1980 [*see* Appendices C and D of IS : 10000 (Part VI)-1980 Methods of tests for internal combustion engines : Part VI Recording of test results].

7.2 *IS Rating* — The power measured on a test bed at the crankshaft or its equivalent at the rated speed specified by the manufacturer and corrected to the standard reference conditions specified in Section II of IS : 10000 (Part II)-1980 the engine being equipped with auxiliaries, necessary for determination of net power [*see* Appendix A of IS : 10000 (Part II)-1980]. This power is also defined as the *Rated Net Brake Power*.

7.3 *Adjustment for Power*

7.3.1 *Power correction factor* 'α' — is the ratio of power output under ambient site conditions to the power output under standard reference conditions specified in Section II of IS : 10000 (Part II)-1980.

$$P_x = \alpha \, . \, P_r$$

where

P_x, P_r and 'α' have same connotations as in 2.3.

7.3.1.1 *Power adjustment factor for diesel engines* — The adjustment factor for naturally aspirated four-stroke and scavenged two-stroke diesel engines is determined by the formula:

$$\alpha = \left(\frac{100}{p}\right)^{0.65} \times \left(\frac{T}{300}\right)^{0.5}$$

where

p = pressure at ambient site conditions, kPa; and

T = absolute air intake temperature at ambient site conditions, K.

7.3.1.1.1 The following formula which is nearly equivalent may also be used :

$$\alpha = 1 + \frac{A}{100}$$

where

$$A = 0{\cdot}65\,(100 - p) + 0{\cdot}17\,(T - 300)$$

p and T have the same connotation as in 7.3.1.1.

7.3.1.1.2 *Limitations in the use of power adjustment factor* — The power adjustment formulae in 7.3.1.1 and 7.3.1.1.1 are only applicable where the adjustment factor 'α' lies between 0·95 and 1·04. If these limits are exceeded the adjusted value obtained shall be given, and the ambient conditions during the tests shall be mentioned in the test report.

7.3.1.2 *Power adjustment factor for spark ignition engines* — is determined by the following formula:

$$\alpha = \left(\frac{100}{p}\right)\left(\frac{T}{300}\right)^{0{\cdot}5}$$

where

p and T have same connotation as in 7.3.1.1.

8. **Declaration of Fuel Consumption** — The engine manufacturer shall state the specific fuel consumption at rated output under the standard reference conditions specified in Section II of IS : 10000 (Part II)-1980 and also at 75, 50 and 25 percent of rated load.

8.1 A tolerance of ± 5 percent in fuel consumption at 100 percent of the rated load throughout the speed range shall be allowed unless otherwise agreed to between the manufacturer and the purchaser.

8.2 The specific fuel consumption at the site conditions shall be corrected to the standard reference conditions specified in Section II of IS : 10000 (Part II)-1980 using specific fuel consumption adjustment factor 'β' given below.

8.2.1 *Specific fuel consumption adjustment factor* 'β' — It is the ratio of the specific fuel consumption under ambient site conditions to the specific fuel consumption under standard reference conditions, that is,

$$\beta = \frac{\text{Specific fuel consumption under ambient site conditions}}{\text{Specific fuel consumption under standard reference conditions}}$$

also,

$$\beta = \frac{k}{\alpha}$$

where

k and α have same connotation as in 2.3.

Note — In deriving this factor, the assumptions made in 2.3.2 are valid.

8.2.2 *Adjustment for calorific value for liquid fuel* — It shall be applied when there is a difference in the net calorific value of the test fuel and that of fuel specified in Section II of IS : 10000 (Part II)-1980. The factor is given by the following formula :

$$\beta_{CV} = \frac{g_{fx} \times CV}{42\,000 \times P_x}$$

where

β_{CV}, g_{fx}, CV and P_x have the same connotation as in 3.2.3.

Note — The specific fuel consumption of a liquid fuel engine is related to reference lower calorific value of 42 000 kJ/kg.

APPENDIX A

(*Clauses* 2.3.1 *and* H-1.7)

DETERMINATION OF THE POWER ADJUSTMENT FACTOR (α)

A-1. The table below gives values of the power adjustment factor (α) for known values of the ratio of indicated power (k) and mechanical efficiency (η_m).

A-2. The value of (k) can be determined from Appendix B.

A-3. The value of η_m is stated by the manufacturer (*see* 2.3, Note 3).

k	α					
	η_m					
	0·70	0·75	0·80	0·85	0·90	0·95
0·50	0·350	0·383	0·413	0·438	0·461	0·482
0·52	0·376	0·408	0·436	0·461	0·483	0·502
0·54	0·402	0 433	0·460	0·483	0·504	0·523
0·56	0·429	0·457	0·483	0·506	0·526	0·544
0·58	0·454	0·482	0·507	0·528	0·547	0·565
0·60	0·480	0·507	0·530	0·551	0·569	0·585
0·62	0·506	0·531	0·554	0·573	0·590	0·606
0·64	0·532	0·556	0·577	0·596	0·612	0·627
0·66	0 558	0·581	0·601	0·618	0·634	0·648
0·68	0·584	0·605	0·624	0·641	0·655	0·668
0·70	0·610	0·630	0·648	0·663	0·677	0·689
0·72	0·636	0·655	0·671	0·685	0·696	0·710
0·74	0·662	0·679	0·695	0·708	0·720	0·730
0·76	0·688	0·704	0·718	0·730	0·741	0·751
0·78	0·714	0·729	0·742	0·753	0·763	0·772
0·80	0·740	0·753	0·766	0·775	0 784	0·793
0·82	0·766	0·778	0·789	0·798	0·806	0·813
0·84	0·792	0·803	0·812	0·820	0·828	0·834
0·86	*0·818*	*0·827*	*0·836*	*0·843*	*0·849*	*0·855*
0·88	0·844	0·852	0·859	0·865	0·871	0·876
0·90	0·870	0·877	0·883	0·888	0·892	0·896
0·92	0·896	0·901	0·906	0·910	0·914	0·917
0·94	0·922	0·926	0·930	0·933	0·935	0·938
0·96	0·948	0·951	0·953	0·955	0·957	0·959
0·98	0·974	0·976	0·977	0·978	0·978	0·979
1·00	1·000	1·000	1·000	1·000	1·000	1·000
1·02	1·026	1·025	1·024	1·023	1·022	1·021
1·04	1·052	1·049	1·047	1·045	1·043	1·042
1·06	1·078	1·074	1·071	1·067	1·065	1·062
1·08	1·104	1·099	1·094	1·090	1·086	1·083
1·10	1·130	1·123	1·118	1·412	1·108	1·104
1·12	1·156	1·148	1·141	1·135	1·129	1·124
1·14	1·182	1·173	1·165	1·157	1·151	1·145
1·16	1·208	1·197	1·188	1·180	1·172	1·166
1·18	1·234	1·222	1·212	1·202	1·194	1·187
1·20	1·260	1·247	1·236	1·225	1·216	1·207

APPENDIX B

(*Clauses* 2.3.1, 3.2.2, A-2, F-2 *and* H-1.4)

DETERMINATION OF THE RATIO OF INDICATED POWER (k)

B-1. Formula (3) in 2.3 can be written as:

$$k = (R_1)^{y_1} (R_2)^{y_2} (R_3)^{y_3}$$

where

$$R_1 = \frac{p_x - a\,\phi_x \cdot p_{ax}}{p_r - a\,\phi_r \cdot p_{ar}},$$

$$R_2 = \frac{T_r}{T_x}, \text{ and}$$

$$R_3 = \frac{T_{cr}}{T_{cx}}$$

and $y_1 = m$, $y_2 = n$, $y_3 = q$

B-2. The value of R (dry air pressure ratio) $= \frac{p_x - a.\phi_x.p_{ax}}{p_r - a.\phi_r.p_{ar}}$ can be obtained from Appendix C and other values of R can be calculated.

B-3. The values of m, n, q are obtained from Table 1.

B-4. The table below then gives values of R^y for known ratios R and known factors y.

B-5. The value of k is then obtained by multiplying together the appropriate values of R^y.

R	R^y								
	y								
	0·5	0·55	0·57	0·7	0·75	0·96	1·2	1·75	2
0·60	0·775	0·755	0·747	0·699	0·682	0·645	0·592	0·409	0·360
0·62	0·787	0·769	0·762	0·716	0·699	0·663	0·564	0·433	0·384
0·64	0·800	0·782	0·775	0·732	0·716	0·681	0·585	0·458	0·410
0·66	0·812	0·796	0·789	0·748	0·732	0·700	0·607	0·483	0·436
0·68	0·825	0·809	0·803	0·763	0·749	0·718	0·630	0·509	0·462
0·70	0·837	0·822	0·816	0·779	0·765	0·736	0·652	0·536	0·490
0·72	0·849	0·835	0·829	0·795	0·782	0·754	0·674	0·563	0·518
0·74	0·860	0·847	0·842	0·810	0·798	0·772	0 697	0·590	0·548
0·76	0·872	0·860	0·855	0·825	0·814	0·790	0·719	0·619	0·578
0·78	0·883	0·872	0·868	0·840	0·830	0·808	0·742	0·647	0·608
0·80	0·894	0·885	0·881	0·855	9·846	0·825	0·765	0·677	0·640
0·82	0·906	0·897	0·893	0·870	0·862	0·843	0·788	0·707	0·672
0·84	0·917	0·909	0·905	0·885	0·877	0·861	0·811	0·737	0·706
0·86	0·927	0·920	0·918	0·900	0·893	0·878	0·834	0·768	0·740
0·88	0·938	0·932	0·930	0·914	0·909	0·896	0·858	0·800	0·774
0·90	0·949	0·944	0·942	0·929	0·924	0·913	0·881	0·832	0·810
0·92	0·959	0·955	0·954	0·943	0·939	0·931	0·905	0·864	0·846
0·94	0·970	0·967	0·965	0·958	0·955	0·948	0·928	0·897	0·884
0·96	0·980	0·978	0·977	0·972	2·970	0·966	0 952	0·931	0·922
0·98	0·990	0 989	0·989	0·986	0·985	0·983	0·976	0·965	0·960
1·00	1·000	1·000	1·000	1·000	1·000	1·000	1·000	1·000	1·000
1·02	1·010	1·011	1·011	1·014	1·015	1·017	1·024	1·035	1·040
1·04	1·020	1·022	1·023	1·023	1·030	1·034	1·048	1·071	1·082
1·06	1·030	1·033	1·034	1·042	1·045	1·051	1·072	1·107	1·124
1·08	1·038	1·043	1·045	1·055	1·059	1·068	1·097	1·144	1·166
1·10	1·049	1·054	1·056	1·069	1·074	1·085	1·121	1·182	1·210
1·12	1·058	1·064	1·067	1·083	1·089	1·102	1·146	1·219	1·254
1·14	1·068	1·075	1·078	1·096	1·103	1·119	1·170	1·258	1·300
1·16	1·077	1·085	1·088	1·110	1·118	1·136	1·195	1·297	1·346
1·18	1·086	1·095	1·099	1·123	1·132	1·153	1·220	1·336	1·392
1·20	1·095	1·106	1·110	1·135	1·147	1·170	1·245	1·376	1·440

APPENDIX C

(Clauses 2.3.1, 3.2.2, A-2 and H-1.3)

DETERMINATION OF DRY AIR PRESSURE RATIO

C-1. The dry air pressure ratio $\frac{p_x - a.\phi_x.p_{sx}}{p_r - a.\phi_r.p_{sr}}$ used in formula (3) in 2.3 is given in the table below for the value of $a = 1$ of formula references A, E and G, and for different values of total barometric pressure (p_x) and water vapour pressure ($\phi_x.p_{sx}$).

C-1.1 If the water vapour pressure is not known it can be obtained from the air temperature and relative humidity by the use of Appendix D.

Altitude	Barometric Pressure p_x	$\frac{p_x - a.\phi_x.p_{sx}}{p_r - a.\phi_r.p_{sr}}$													
		$\phi_x.p_{sx}$ (kPa)													
m	kPa	0	1	2	3	4	5	6	7	8	9	10	11	12	13
0	101·3	1·04	1·02	1·01	1·00	0·99	0·98	0·97	0·96	0·95	0·94	0·93	0·92	0·91	0·90
100	100·0	1·02	1·01	1·00	0·99	0·98	0·97	0·96	0·95	0·94	0·93	0·92	0·91	0·90	0·89
200	98·9	1·01	1·00	0·99	0·98	0·97	0·96	0·95	0·94	0·93	0·92	0·91	0·90	0·89	0·88
400	96·7	0·99	0·98	0·97	0·96	0·95	0·94	0·93	0·92	0·91	0·90	0·89	0·88	0·87	0·86
600	94·4	0·96	0·95	0·94	0·93	0·92	0·91	0·90	0·89	0·88	0·87	0·86	0·85	0·84	0·83
800	92·1	0·94	0·93	0·92	0·91	0·90	0·89	0·88	0·87	0·86	0·85	0·84	0·83	0·82	0·81
1 000	89·9	0·92	0·91	0·90	0·89	0·88	0·87	0·86	0·85	0·84	0·83	0·82	0·81	0·80	0·79
1 200	87·7	0·90	0·89	0·88	0·87	0·86	0·85	0·84	0·83	0·81	0·80	0·79	0·78	0·77	0·76
1 400	85·6	0·87	0·86	0·85	0·84	0·83	0·82	0·81	0·80	0·79	0·78	0·77	0·76	0·75	0·74
1 600	83·5	0·85	0·84	0·83	0·82	0·81	0·80	0·79	0·78	0·77	0·76	0·75	0·74	0·73	0·72
1 800	81·5	0·83	0·82	0·81	0·80	0·79	0·78	0·77	0·76	0·75	0·74	0·73	0·72	0·71	0·70
2 000	79·5	0·81	0·80	0·79	0·78	0·77	0·76	0·75	0·74	0·73	0·72	0·71	0·70	0·69	0·68
2 200	77·6	0·79	0·78	0·77	0·76	0·75	0·74	0·73	0·72	0·71	0·70	0·69	0·68	0·67	0·66
2 400	75·6	0·77	0·76	0·75	0·74	0·73	0·72	0·71	0·70	0·69	0·68	0·67	0·66	0·65	0·64
2 600	73·7	0·75	0·74	0·73	0·72	0·71	0·70	0·69	0·68	0·67	0·66	0·65	0·64	0·63	0·62
2 800	71·9	0·73	0·72	0·71	0·70	0·69	0·68	0·67	0·66	0·65	0·64	0·63	0·62	0·61	0·60
3 000	70·1	0·72	0·71	0·70	0·69	0·68	0·67	0·66	0·64	0·63	0·62	0·61	0·60	0·59	0·58
3 200	68·4	0·70	0·69	0·68	0·67	0·66	0·65	0·64	0·63	0·62	0·61	0·60	0·59	0·58	0·57
3 400	66·7	0·68	0·67	0·66	0·65	0·64	0·63	0·62	0·61	0·60	0·59	0·58	0·57	0·56	0·55
3 600	64·9	0·66	0·65	0·64	0·63	0·62	0·61	0·60	0·59	0·58	0·57	0·56	0·55	0·54	0·53
3 800	63·2	0·65	0·64	0·63	0·62	0·60	0·59	0·58	0·57	0·56	0·55	0·54	0·53	0·52	0·51
4 000	61·5	0·63	0·62	0·61	0·60	0·59	0·58	0·57	0·56	0·55	0·54	0·53	0·52	0·51	0·50
4 200	60·1	0·61	0·60	0·59	0·58	0·57	0·56	0·55	0·54	0·53	0·52	0·51	0·50	0·49	0·48
4 400	58·5	0·60	0·59	0·58	0·54	0·56	0·55	0·54	0·53	0·52	0·51	0·50	0·49	0·48	0·47
4 600	56·9	0·58	0·57	0·56	0·55	0·54	0·53	0·52	0·51	0·50	0·49	0·48	0·47	0·46	0·45
4 800	55·3	0·57	0·56	0·54	0·53	0·52	0·51	0·50	0·49	0·48	0·47	0·46	0·45	0·44	0·43
5 000	54·1	0·55	0·54	0·53	0·52	0·51	0·50	0·49	0·48	0·47	0·46	0·45	0·44	0·43	0·42

APPENDIX D

(*Clauses* 2.3.1, 3.2.2, C-1.1 *and* H-1.2)

DETERMINATION OF WATER VAPOUR PRESSURE

D-1. The water vapour pressure ($\phi_x.p_{sx}$) is given in the table below for different values of the air temperature t_x in degrees Celsius and relative humidity ϕ_x.

t_x (°C)	$\phi_x.p_{sx}$ (kPa)				
	ϕ_x				
	1	0·8	0·6	0·4	0·2
−10	0·3	0·2	0·2	0·1	0·1
− 5	0·4	0·3	0·2	0·2	0·1
0	0·6	0·5	0·4	0·2	0·1
5	0·9	0·7	0·5	0·4	0·2
10	1·2	1	0·7	0·5	0·2
15	1·7	1·4	1	0·7	0·3
20	2·3	1·9	1·4	0·9	0·5
25	3·2	2·5	1·9	1·3	0·6
27	3·5	2·9	2·1	1·4	0·7
30	4·2	3·4	2·5	1·7	0·9
32	4·8	3·8	2·9	1·9	1
34	5·3	4·3	3·2	2·1	1·1
36	6	4·8	3·6	2·4	1·2
38	6·6	5·3	4	2·7	1·3
40	7·4	5·9	4·4	3	1·5
42	8·2	6·6	4·9	3·3	1·6
44	9·1	7·3	5·5	3·6	1·8
46	10·1	8·1	6·1	4	2
48	11·2	8·9	6·7	4·5	2·2
50	12·3	9·9	7·4	4·9	2·5

APPENDIX E

(*Clause* 2.3.1)

POWER CORRECTION ADJUSTMENT FACTOR ALPHA (α) FOR NON-TURBOCHARGED CONSTANT SPEED ENGINES THE PERFORMANCE OF WHICH IS LIMITED BY AIR EXCESS FOR 70 PERCENT MECHANICAL EFFICIENCY

Height Above Sea Level	Air Pressure	Temperature of Inlet Air (Celsius) at 90 Percent Relative Humidity											
m	mm-Hg	0	5	10	15	20	25	27	30	35	40	45	50
0	760·0	1·11	1·09	1·08	1·06	1·04	1·03	1·02	1·01	0·99	0·96	0·93	0·90
100	751·0	1·09	1·07	1·06	1·04	1·03	1·01	1·00	0·99	0·97	0·94	0·92	0·89
200	742·0	1·07	1·06	1·04	1·03	1·01	0·99	0·99	0·97	0·96	0·93	0·90	0·87
300	733·0	1·06	1·04	1·03	1·01	0·99	0·98	0·97	0·96	0·94	0·91	0·89	0·86
400	725·0	1·04	1·03	1·01	1·00	0·98	0·96	0·96	0·94	0·93	0·90	0·87	0·84
500	716·0	1·02	1·01	1·00	0·98	0·96	0·95	0·94	0·93	0·91	0·88	0·86	0·83
600	708·0	1·01	1·00	0·98	0·97	0·95	0·93	0·93	0·91	0·90	0·87	0·84	0·81
700	699·0	0·99	0·98	0·97	0·95	0·93	0·92	0·91	0·90	0·88	0·85	0·83	0·80
800	691·0	0·98	0·96	0·96	0·94	0·92	0·90	0·90	0·88	0·87	0·84	0·81	0·78
900	682·0	0·96	0·95	0·93	0·92	0·90	0·89	0·88	0·87	0·85	0·83	0·80	0·77
1 000	674·0	0·95	0·93	0·92	0·90	0·89	0·87	0·87	0·85	0·84	0·81	0·78	0·76
1 100	666·0	0·93	0·92	0·90	0·89	0·87	0·86	0·85	0·84	0·82	0·80	0·77	0·74
1 200	658·0	0·92	0·90	0·89	0·88	0·86	0·84	0·84	0·83	0·81	0·78	0·76	0·73
1 300	650·0	0·90	0·89	0·88	0·86	0·85	0·83	0·82	0·81	0·80	0·77	0·74	0·72
1 400	642 0	0·89	0·87	0·86	0·85	0·83	0·82	0·81	0·80	0·78	0·76	0·73	0·70
1 500	634·0	0·87	0·86	0·85	0·83	0·82	0·80	0·79	0·78	0·77	0·74	0·72	0·69
1 600	626·0	0·86	0·84	0·83	0·82	0·80	0·79	0·78	0·77	0·75	0·73	0·70	0·67
1 700	618·0	0·84	0·83	0·82	0·80	0·79	0·77	0·77	0·76	0·74	0·71	0·69	0·66
1 800	611·0	0·83	0·82	0·80	0·79	0·78	0·76	0·75	0·74	0·73	0·70	0·68	0·65
1 900	600·0	0·81	0·80	0·78	0·77	0·76	0·74	0·73	0·72	0·71	0·68	0·66	0·63
2 000	596·0	0·80	0·79	0·78	0·76	0·75	0·73	0·73	0·72	0·70	0·68	0·65	0·62
2 100	589·0	0·79	0·78	0·76	0·75	0·74	0·72	0·72	0·71	0·69	0·66	0·64	0·61
2 200	582·0	0·78	0·76	0·75	0·74	0·72	0·71	0·70	0·69	0·68	0·65	0·63	0·60
2 300	574·0	0·76	0·75	0·74	0·72	0·71	0·69	0·69	0·68	0·66	0·64	0·61	0·59
2 400	567·0	0·75	0·74	0·72	0·71	0·70	0·68	0·68	0·67	0·65	0·63	0·60	0·57
2 500	560·0	0·73	0·72	0·71	0·70	0·68	0·67	0·66	0·65	0·64	0·61	0·59	0·56
2 600	553·0	0·72	0·71	0·70	0·69	0·67	0·66	0·65	0·64	0·63	0·60	0·58	0·55
2 700	546·0	0·71	0·70	0·69	0·67	0·66	0·64	0·64	0·63	0·61	0·59	0·56	0·54
2 800	539·0	0·70	0·68	0·67	0·66	0·65	0·63	0·63	0·62	0·60	0·58	0·55	0·53
2 900	532·0	0·68	0·67	0·66	0·65	0·63	0·62	0·61	0·60	0·59	0·57	0·54	0·51
3 000	526·0	0·67	0·66	0·65	0·64	0·62	0·61	0·60	0·59	0·58	0·55	0·53	0·50
3 100	519·0	0·66	0·65	0·64	0·62	0·61	0·60	0·59	0·58	0·57	0·54	0·52	0·49
3 200	513·0	0·65	0·64	0·63	0·61	0·60	0·59	0·58	0·57	0·56	0·53	0·51	0·48
3 300	506·0	0·63	0·62	0·61	0·60	0·59	0·57	0·57	0·56	0·54	0·52	0·50	0·47
3 400	500·0	0·62	0·61	0·60	0·59	0·58	0·56	0·56	0·55	0·53	0·51	0·49	0·46
3 500	493·0	0·61	0·60	0·59	0·58	0·56	0·55	0·55	0·54	0·52	0·50	0·47	0·45
3 600	487·0	0·60	0·59	0·58	0·57	0·55	0·54	0·53	0·53	0·51	0·49	0·46	0·44
3 700	481·0	0·59	0·58	0·57	0·56	0·54	0·53	0·52	0·51	0·50	0·48	0·45	0·43
3 800	474·0	0·57	0·57	0·55	0·54	0·53	0·52	0·51	0·50	0·49	0·46	0·44	0·41
3 900	468·0	0·56	0·55	0·54	0·53	0·52	0·51	0·50	0·49	0·48	0·45	0·43	0·40
4 000	462·0	0·55	0·54	0·53	0·52	0·51	0·50	0·49	0·48	0·47	0·44	0·42	0·39
4 100	456·0	0·54	0·53	0·52	0·51	0·50	0·49	0·48	0·47	0·46	0·43	0·41	0·38
4 200	451·0	0·53	0·52	0·51	0·50	0·49	0·48	0·47	0·46	0·45	0·42	0·40	0·38
4 300	445·0	0·52	0·51	0·50	0·49	0·48	0·47	0·46	0·45	0·44	0·41	0·39	0·37
4 400	439·0	0·51	0·50	0·49	0·48	0·47	0·45	0·45	0·44	0·43	0·40	0·38	0·35
4 500	433·0	0·50	0·49	0·48	0·47	0·46	0·44	0·44	0·43	0·42	0·39	0·37	0·34
4 600	427·0	0·49	0·48	0·47	0·46	0·45	0·43	0·43	0·42	0·41	0·38	0·36	0·33
4 700	421·0	0·48	0·47	0·46	0·45	0·44	0·42	0·42	0·41	0·40	0·37	0·35	0·32
4 800	415·0	0·46	0·46	0·45	0·44	0·42	0·41	0·41	0·40	0·39	0·36	0·34	0·31
4 900	410·0	0·46	0·45	0·44	0·43	0·42	0·40	0·40	0·39	0·38	0·35	0·33	0·31
5 000	405·0	0·45	0·44	0·43	0·42	0·41	0·39	0·39	0·38	0·37	0·35	0·32	0·30

Standard reference conditions { Mean barometric pressure = 100 kPa (750 mm of mercury)
Intake air temperature 300 K (27°C)
Relative humidity = 60 percent at 300 K

(*Continued*)

APPENDIX E

POWER CORRECTION ADJUSTMENT FACTOR ALPHA (α) FOR NON-TURBOCHARGED CONSTANT SPEED ENGINES THE PERFORMANCE OF WHICH IS LIMITED BY AIR EXCESS FOR 70 PERCENT MECHANICAL EFFICIENCY — *Contd*

Height Above Sea Level	Air Pressure	Temperature of Inlet Air (Celsius) at 90 Percent Relative Humidity											
m	mm-Hg	0	5	10	15	20	25	27	30	35	40	45	50
0	760·0	1·10	1·09	1·07	1·05	1·04	1·02	1·01	0·99	0·97	0·94	0·91	0·87
100	751·0	1·09	1·07	1·06	1·04	1·02	1·00	0·99	0·96	0·95	0·93	0·89	0·86
200	742·0	1·07	1·06	1·04	1·02	1·00	0·99	0·98	0·96	0 94	0·91	0·88	0·84
300	733·0	1·05	1·04	1·02	1·01	0·99	0·97	0·96	0·95	0·92	0·89	0·86	0·82
400	725·0	1·04	1·02	1·01	0·99	0·97	0·96	0·95	0·93	0 91	0·88	0·85	0·81
500	716·0	1·02	1·01	0·99	0·98	0·96	0·94	0·93	0·92	0·89	0·86	0·83	0·80
600	708·0	1·01	0·99	0·98	0·96	0·94	0·92	0·92	0·90	0·88	0·85	0·82	0·78
700	699·0	0·99	0·98	0·96	0 94	0·93	0·91	0·90	0·89	0·86	0·84	0·80	0·77
800	691·0	0·98	0·96	0 95	0·93	0·91	0·89	0·89	0·87	0·85	0·82	0·79	0·75
900	682·0	0·96	0·95	0·93	0·91	0·90	0·88	0·87	0·86	0·83	0·81	0·77	0·74
1 000	674·0	0·94	0·93	0·92	0·90	0·88	0·86	0·86	0·84	0·82	0·79	0·76	0·72
1 100	666·0	0·93	0·92	0·90	0·88	0·87	0·85	0·84	0·83	0·80	0·78	0·75	0·71
1 200	658·0	0·91	0·90	0·89	0·87	0·85	0·84	0·83	0·81	0·79	0·76	0·73	0·70
1 300	650·0	0·90	0·89	0·87	0·86	0·84	0·82	0·81	0·80	0·78	0·75	0·72	0·68
1 400	642·0	0·89	0·87	0·86	0·84	0·83	0·81	0·80	0·79	0·76	0 74	0·71	0·67
1 500	634·0	0·87	0·86	0·84	0·83	0·81	0·79	0·78	0·77	0·75	0·72	0·69	0·66
1 600	626·0	0·86	0·84	0·83	0·81	0·80	0·78	0·77	0·76	0·73	0·71	0·68	0·64
1 700	618·0	0·84	0·83	0·81	0·80	0·78	0·76	0·76	0·74	0·72	0·69	0·66	0·63
1 800	611·0	0·83	0·81	0·80	0·79	0·77	0·75	0·74	0·73	0·71	0·68	0·65	0·62
1 900	603·0	0·81	0·79	0·78	0·77	0·75	0·73	0·72	0·71	0·69	0·66	0·63	0·60
2 000	596·0	0·80	0·79	0·77	0·76	0·74	0·73	0·72	0·71	0·68	0·66	0·63	0·59
2 100	589·0	0·79	0·77	0·76	0·75	0·73	0·71	0·70	0·69	0·67	0·64	0·61	0·58
2 200	582·0	0·77	0·76	0·75	0·73	0·72	0·70	0·69	0·68	0·66	0·63	0·60	0·57
2 300	574·0	0·76	0·75	0·73	0·72	0·70	0·69	0·68	0·67	0·64	0·62	0·59	0·55
2 400	567·0	0·75	0·73	0·72	0·71	0·69	0·67	0·67	0·65	0·63	0·61	0·58	0·54
2 500	560·0	0·73	0·72	0·71	0·69	0·68	0·66	0·65	0·64	0·62	0·59	0·56	0·53
2 600	553·0	0·72	0·71	0·69	0·68	0·67	0·65	0·64	0·63	0·61	0·58	0·55	0·52
2 700	546·0	0·71	0·69	0·68	0·67	0·65	0·64	0·63	0·62	0·59	0·57	0·54	0·51
2 800	539·0	0·69	0·68	0·67	0·66	0·64	0·62	0·62	0·60	0·58	0·56	0·53	0·49
2 900	532·0	0·68	0·67	0·66	0·64	0·63	0·61	0·60	0·59	0·57	0·55	0·52	0·48
3 000	526·0	0·67	0·66	0·65	0·63	0·62	0·60	0·59	0·58	0·56	0·54	0·51	0·47
3 100	519·0	0·66	0·65	0·63	0·62	0·60	0·59	0·58	0·57	0·55	0·52	0·49	0·46
3 200	513·0	0·65	0·63	0·62	0·61	0·59	0·58	0·57	0·56	0·54	0·51	0·48	0 45
3 300	506·0	0·63	0·62	0·61	0·60	0·58	0·57	0·56	0·55	0·52	0·50	0·47	0·44
3 400	500·0	0·62	0·61	0 60	0·58	0·57	0·56	0·55	0·54	0·51	0·49	0·46	0·43
3 500	493·0	0·61	0·60	0·59	0·57	0·56	0·54	0·53	0·52	0·50	0·48	0·45	0·42
3 600	487·0	0·60	0·59	0·57	0·56	0·55	0·53	0·52	0·51	0·49	0·47	0·44	0·41
3 700	481·0	0·59	0·58	0·56	0·55	0·54	0·52	0·51	0·50	0·48	0·46	0·43	0·40
3 800	474·0	0·57	0·56	0·55	0·54	0·52	0·51	0·50	0·49	0·47	0·45	0·42	0·38
3 900	468·0	0·56	0·55	0·54	0·53	0·51	0·50	0·49	0·48	0·46	0·43	0·41	0·37
4 000	462·0	0·55	0·54	0·53	0·52	0·50	0·49	0·48	0·47	0·45	0·42	0·40	0·36
4 100	456·0	0·54	0·53	0·52	0·51	0·49	0·48	0·47	0·46	0·44	0·41	0·39	0·35
4 200	451·0	0·53	0·52	0·51	0·50	0·48	0·47	0·46	0·45	0·43	0·41	0·38	0·34
4 300	445 0	0·52	0·51	0·50	0·49	0·47	0·46	0·45	0·44	0·42	0·39	0·37	0·33
4 400	439·0	0·51	0·50	0·49	0·47	0·46	0·45	0·44	0·43	0·41	0·38	0·36	0·32
4 500	433·0	0·50	0·49	0·48	0 46	0·45	0·44	0·43	0·42	0·40	0·37	0·35	0·31
4 600	427·0	0·49	0·48	0·46	0·45	0·44	0·43	0·42	0·41	0·39	0·36	0·34	0·30
4 700	421·0	0·47	0·46	0·45	0·44	0·43	0·41	0·41	0·40	0·38	0·35	0·32	0·29
4 800	415·0	0·46	0·45	0·44	0·43	0·42	0·40	0·40	0·39	0·37	0·34	0·31	0·28
4 900	410·0	0·45	0·44	0·43	0·42	0·41	0·40	0·39	0·38	0·36	0·33	0·31	0·27
5 000	405·0	0·45	0·44	0·42	0·41	0·40	0·39	0·38	0·37	0·35	0·33	0·30	0·27

Standard reference conditions { Mean barometric pressure = 100 kPa (760 mm of mercury)
Intake air temperature 300 K (27° C)
Relative humidity = 80 percent at 300 K

(*Continued*)

APPENDIX E

POWER CORRECTION ADJUSTMENT FACTOR ALPHA (α) FOR NON-TURBOCHARGED CONSTANT SPEED ENGINES THE PERFORMANCE OF WHICH IS LIMITED BY AIR EXCESS FOR 70 PERCENT MECHANICAL EFFICIENCY — *Contd*

Height Above Sea Level	Air Pressure	Temperature of Inlet Air (Celsius) at 100 Percent Relative Humidity											
m	mm-Hg	0	5	10	15	20	25	27	30	35	40	45	50
0	760·0	1·10	1·09	1·07	1·05	1·03	1·01	1·00	0·98	0·95	0·92	0·88	0·84
100	751·0	1·09	1·07	1·05	1·03	1·01	0·99	0·98	0·97	0·94	0·91	0·87	0·82
200	742·0	1·07	1·06	1·04	1·02	1·00	0·98	0·97	0·96	0·92	0·89	0·85	0·81
300	733·0	1·06	1·04	1·02	1·00	0·98	0·96	0·94	0·91	0·87	0·84	0·79	
400	725·0	1·04	1·02	1·01	0·99	0·97	0·95	0·94	0·92	0·89	0·86	0·82	0·78
500	716·0	1·02	1·00	0·98	0·97	0·95	0·93	0·92	0·91	0·88	0·85	0·81	0·76
600	708·0	1·01	0·99	0·97	0·96	0·94	0·92	0·91	0·89	0·86	0·83	0·79	0·75
700	699·0	0·99	0·97	0·96	0·94	0·92	0·90	0·89	0·88	0·85	0·82	0·78	0·74
800	691·0	0·97	0·95	0·94	0·93	0·91	0·89	0·88	0·86	0·83	0·80	0·76	0·72
900	682·0	0·96	0·94	0·93	0·91	0·89	0·87	0·86	0·85	0·82	0·79	0·75	0·71
1 000	674·0	0·94	0·93	0·91	0·90	0·88	0·86	0·85	0·83	0·80	0·77	0·74	0·69
1 100	666·0	0·93	0·91	0·90	0·88	0·86	0·84	0·83	0·82	0·79	0·76	0·72	0·68
1 200	658·0	0·91	0·90	0·88	0·87	0·85	0·83	0·82	0·80	0·78	0·74	0·71	0·67
1 300	650·0	0·90	0·88	0·87	0·85	0·83	0·81	0·80	0·79	0·76	0·73	0·69	0·65
1 400	642·0	0·88	0·87	0·85	0·84	0·82	0·80	0·79	0·78	0·75	0·72	0·68	0·64
1 500	634·0	0·87	0·85	0·84	0·82	0·81	0·78	0·78	0·76	0·73	0·70	0·67	0·62
1 600	626·0	0·85	0·84	0·83	0·81	0·79	0·77	0·76	0·75	0·72	0·69	0·65	0·61
1 700	618·0	0·84	0·82	0·81	0·79	0·78	0·76	0·75	0·73	0·71	0·68	0·64	0·60
1 800	611·0	0·83	0·81	0·80	0·78	0·76	0·74	0·73	0·72	0·69	0·66	0·63	0·59
1 900	603·0	0·81	0·79	0·78	0·76	0·74	0·72	0·71	0·70	0·67	0·64	0·61	0·57
2 000	595·0	0·80	0·78	0·77	0·75	0·74	0·72	0·71	0·69	0·67	0·64	0·60	0·56
2 100	589·0	0·79	0·77	0·76	0·74	0·72	0·70	0·70	0·68	0·66	0·63	0·59	0·56
2 200	582·0	0·77	0·76	0·74	0·73	0·71	0·69	0·68	0·67	0·64	0·61	0·58	0·54
2 300	574·0	0·76	0·74	0·73	0·71	0·70	0·68	0·67	0·66	0·63	0·60	0·56	0·52
2 400	567·0	0·74	0·73	0·72	0·70	0·69	0·66	0·66	0·64	0·62	0·59	0·55	0·51
2 500	560·0	0·73	0·72	0·70	0·69	0·67	0·65	0·64	0·63	0·60	0·57	0·54	0·49
2 600	553·0	0·72	0·71	0·69	0·68	0·66	0·64	0·63	0·62	0·59	0·56	0·53	0·49
2 700	546·0	0·71	0·69	0·68	0·66	0·65	0·63	0·62	0·61	0·58	0·55	0·52	0·47
2 800	539·0	0·69	0·68	0·67	0·65	0·64	0·62	0·61	0·59	0·57	0·54	0·50	0·46
2 900	532·0	0·68	0·67	0·65	0·64	0·62	0·60	0·59	0·58	0·56	0·53	0·49	0·45
3 000	526·0	0·67	0·65	0·64	0·63	0·61	0·59	0·58	0·57	0·55	0·52	0·48	0·44
3 100	519·0	0·65	0·64	0·63	0·62	0·60	0·58	0·57	0·56	0·53	0·50	0·47	0·43
3 200	513·0	0·64	0·63	0·62	0·60	0·59	0·57	0·56	0·55	0·52	0·49	0·46	0·42
3 300	505·0	0·63	0·62	0·61	0·59	0·58	0·56	0·56	0·54	0·51	0·48	0·45	0·41
3 400	500·0	0·62	0·61	0·60	0·58	0·57	0·55	0·54	0·53	0·50	0·47	0·44	0·40
3 500	493·0	0·61	0·59	0·58	0·57	0·56	0·53	0·53	0·51	0·49	0·46	0·42	0·38
3 600	487·0	0·60	0·58	0·57	0·56	0·54	0·52	0·51	0·50	0·48	0·45	0·41	0·37
3 700	481·0	0·58	0·57	0·56	0·55	0·53	0·51	0·50	0·49	0·47	0·44	0·40	0·36
3 800	474·0	0·57	0·56	0·55	0·53	0·52	0·50	0·49	0·48	0·45	0·43	0·39	0·35
3 900	468·0	0·56	0·55	0·54	0·52	0·51	0·49	0·48	0·47	0·44	0·42	0·38	0·34
4 000	462·0	0·55	0·54	0·53	0·51	0·50	0·48	0·47	0·46	0·43	0·40	0·37	0·33
4 100	456·0	0·54	0·53	0·52	0·50	0·49	0·47	0·46	0·45	0·42	0·39	0·36	0·32
4 200	451·0	0·53	0·52	0·51	0·49	0·48	0·46	0·45	0·44	0·41	0·38	0·35	0·31
4 300	445·0	0·52	0·51	0·50	0·48	0·47	0·45	0·44	0·43	0·40	0·38	0·34	0·30
4 400	439·0	0·51	0·50	0·48	0·47	0·46	0·44	0·43	0·42	0·39	0·36	0·33	0·29
4 500	433·0	0·50	0·48	0·47	0·46	0·45	0·43	0·42	0·41	0·38	0·35	0·32	0·28
4 600	427·0	0·48	0·47	0·46	0·45	0·43	0·42	0·41	0·40	0·37	0·34	0·31	0·27
4 700	421·0	0·47	0·46	0·45	0·44	0·42	0·41	0·40	0·39	0·36	0·33	0·30	0·26
4 800	415·0	0·46	0·45	0·44	0·43	0·41	0·39	0·39	0·38	0·35	0·32	0·29	0·25
4 900	410·0	0·45	0·44	0·43	0·42	0·40	0·39	0·38	0·37	0·34	0·31	0·28	0·24
5 000	403·0	0·44	0·43	0·42	0·41	0·39	0·38	0·37	0·36	0·33	0·31	0·27	0·23

Standard reference conditions { Mean barometric pressure — 100 kPa (750 mm of mercury)
Intake air temperature 300 K (27 °C)
Relative humidity — 80 percent at 300 K

(*Continued*)

APPENDIX E

POWER CORRECTION ADJUSTMENT FACTOR ALPHA (α) FOR NON-TURBOCHARGED CONSTANT SPEED ENGINES THE PERFORMANCE OF WHICH IS LIMITED BY AIR EXCESS FOR 75 PERCENT MECHANICAL EFFICIENCY — *Contd*

Height Above Sea Level	Air Pressure	Temperature of Inlet Air (Celsius) at 60 Percent Relative Humidity											
m	mm-Hg	0	5	10	15	20	25	27	30	35	40	45	50
0	760·0	1·10	1·09	1·07	1·06	1·04	1·02	1·02	1·01	0·99	0·96	0·94	0·91
100	751·0	1·08	1·07	1·06	1·04	1·03	1·01	1·00	0·99	0·97	0·95	0·92	0·89
200	742·0	1·07	1·06	1·04	1·03	1·01	0·99	0·99	0·98	0·96	0·93	0·91	0·88
300	733·0	1·05	1·04	1·03	1·01	1·00	0·98	0·97	0·96	0·94	0·92	0·89	0·86
400	725·0	1·04	1·03	1·01	1·00	0·98	0·96	0·96	0·95	0·93	0·91	0·88	0·85
500	716·0	1·02	1·01	1·00	0·98	0·97	0·95	0·94	0·93	0·92	0·89	0·86	0·84
600	708·0	1·01	1·00	0·98	0·97	0·95	0·94	0·93	0·92	0·90	0·88	0·85	0·82
700	699·0	0·99	0·98	0·97	0·95	0·94	0·92	0·91	0·90	0·89	0·86	0·84	0·81
800	691·0	0·98	0·97	0·96	0·94	0·92	0·91	0·90	0·89	0·87	0·85	0·82	0·80
900	682·0	0·96	0·95	0·94	0·92	0·91	0·89	0·89	0·88	0·86	0·83	0·81	0·78
1 000	674·0	0·95	0·94	0·92	0·91	0·89	0·88	0·87	0·86	0·85	0·82	0·80	0·77
1 100	666·0	0·93	0·92	0·91	0·90	0·88	0·87	0·86	0·85	0·83	0·81	0·78	0·76
1 200	658·0	0·92	0·91	0·90	0·88	0·87	0·85	0·85	0·84	0·82	0·79	0·77	0·74
1 300	650·0	0·91	0·89	0·88	0·87	0·85	0·84	0·83	0 82	0·81	0·78	0·76	0·73
1 400	642·0	0·89	0·88	0·87	0·85	0·84	0·83	0·82	0·81	0·79	0·77	0·74	0·72
1 500	634·0	0·88	0·87	0·85	0·84	0·83	0·81	0·81	0·80	0·78	0·76	0·73	0·70
1 600	626·0	0·86	0·85	0·84	0·83	0·81	0·80	0·79	0·78	0·77	0·74	0·72	0·69
1 700	618·0	0·85	0·84	0·83	0·81	0·80	0·78	0·78	0·77	0·75	0 73	0·70	0·68
1 800	611·0	0·84	0·83	0·81	0·80	0·79	0·77	0·77	0·76	0·74	0·72	0·69	0·67
1 900	600·0	0·82	0·81	0·80	0·78	0·77	0·75	0·75	0·74	0·72	0·70	0·67	0·65
2 000	596·0	0·81	0·80	0·79	0·78	0·76	0·75	0·74	0·73	0·72	0·69	0·67	0·64
2 100	589·0	0·80	0·79	0·78	0·76	0·75	0·74	0·73	0·72	0·71	0·68	0·66	0·63
2 200	582·0	0·78	0·78	0·76	0·75	0·74	0·72	0·72	0·71	0·69	0·67	0·65	0·62
2 300	574·0	0·77	0·76	0·75	0·74	0·72	0·71	0·70	0·70	0·68	0·66	0·63	0·61
2 400	567·0	0·76	0·75	0·74	0·73	0·71	0·70	0·69	0·68	0·67	0·65	0·62	0·60
2 500	560·0	0·75	0·74	0·73	0·71	0·70	0·69	0·68	0·67	0·66	0 63	0·61	0·58
2 600	553·0	0·74	0·73	0·71	0·70	0·69	0·68	0·67	0·66	0·65	0·62	0·60	0·57
2 700	546·0	0·72	0·71	0·70	0·69	0·68	0·66	0·66	0·65	0·63	0 61	0·59	0·56
2 800	539·0	0·71	0·70	0·69	0·68	0·67	0·65	0·65	0·64	0·62	0·60	0·58	0·55
2 900	532·0	0·70	0·69	0·68	0·67	0·65	0·64	0·63	0·62	0·61	0·59	0·56	0·54
3 000	526·0	0·69	0·68	0·67	0·66	0·64	0·63	0·62	0·61	0·60	0·58	0·55	0·53
3 100	519·0	0·68	0·67	0·66	0·64	0·63	0·62	0·61	0·60	0·59	0·57	0·54	0·52
3 200	513·0	0·67	0·66	0·65	0·63	0·62	0·61	0·60	0·59	0·58	0 56	0·53	0·51
3 300	506·0	0·66	0·64	0·63	0·62	0·61	0·60	0·59	0·58	0·57	0·54	0·52	0·50
3 400	500·0	0·64	0·63	0·62	0·61	0·60	0·59	0·58	0·57	0·56	0·53	0·51	0·49
3 500	493·0	0·63	0·62	0·61	0·60	0·59	0·57	0·57	0·56	0·55	0·52	0·50	0·48
3 600	487·0	0·62	0·61	0·60	0·59	0·58	0·58	0·56	0·55	0·54	0·51	0·49	0·47
3 700	481·0	0·61	0·60	0·59	0·58	0·57	0·56	0·55	0·54	0·53	0·50	0·48	0·46
3 800	474·0	0·60	0·59	0·58	0·57	0·55	0·54	0·54	0·53	0·51	0·49	0·47	0·44
3 900	468·0	0·59	0·58	0·57	0·56	0·54	0·53	0·53	0·52	0·50	0·48	0·46	0·43
4 000	462·0	0·58	0·57	0·56	0·55	0·53	0·52	0·52	0·51	0·49	0·47	0·45	0·43
4 100	456·0	0·56	0·56	0·55	0·54	0·52	0·51	0·51	0·50	0·48	0·46	0·44	0·42
4 200	451·0	0·56	0·55	0·54	0·53	0·52	0·50	0·50	0·49	0·48	0·45	0·43	0·41
4 300	445·0	0·55	0·54	0·53	0·52	0·51	0·49	0·49	0·48	0·47	0·44	0·42	0·40
4 400	439·0	0·53	0·53	0·52	0·51	0·50	0·48	0·48	0·47	0·46	0·43	0·41	0·39
4 500	433·0	0·52	0·52	0·51	0·50	0·49	0·47	0·47	0 48	0·45	0·42	0·40	0·38
4 600	427·0	0·51	0·51	0·50	0·49	0·47	0·46	0·46	0·45	0·44	0 43	0·40	0·38	0·37
4 700	421·0	0·50	0·50	0·49	0·48	0·46	0·45	0·45	0·44	0 43	0·40	0·38	0·36
4 800	415·0	0·49	0·48	0·48	0·47	0·45	0·44	0·44	0·43	0·42	0·40	0·37	0·35
4 900	410·0	0·48	0·48	0·47	0·46	0·45	0·43	0·43	0·42	0·41	0·39	0·36	0·34
5 000	405·0	0·47	0·47	0·46	0·45	0·44	0·43	0·42	0·41	0·40	0·38	0·36	0·33

Standard reference conditions { Mean barometric pressure = 100 kPa (750 mm of mercury)
Intake air temperature 300 K (27 °C)
Relative humidity = 60 percent at 300 K

(*Continued*)

APPENDIX E

POWER CORRECTION ADJUSTMENT FACTOR ALPHA (α) FOR NON-TURBOCHARGED CONSTANT SPEED ENGINES THE PERFORMANCE OF WHICH IS LIMITED BY AIR EXCESS FOR 75 PERCENT MECHANICAL EFFICIENCY — *Contd*

Height Above Sea Level	Air Pressure	Temperature of Inlet Air (Celsius) at 90 Percent Relative Humidity											
m	mm-Hg	0	5	10	15	20	25	27	30	35	40	45	50
0	760·0	1·10	1·08	1·07	1·05	1·03	1·02	1·01	0·99	0·97	0·94	0·91	0·88
100	751·0	1·08	1·07	1·05	1·04	1·02	1·00	0·99	0·98	0·96	0·93	0·90	0·86
200	742·0	1·07	1·05	1·04	1·02	1·00	0·99	0·98	0·96	0·94	0·91	0·88	0·85
300	733·0	1·05	1·04	1·02	1·01	0·99	0·97	0·96	0·95	0·93	0·90	0·87	0·83
400	725·0	1·04	1·02	1·01	0·99	0·98	0·96	0·95	0·94	0·91	0·89	0·86	0·82
500	716·0	1·02	1·01	0·99	0·98	0·96	0·94	0·93	0·92	0·90	0·87	0·84	0·81
600	708·0	1·01	0·99	0·98	0·96	0·95	0·93	0·92	0·91	0·88	0·86	0·83	0·79
700	699·0	0·99	0·98	0·96	0·95	0·93	0·91	0·90	0·89	0·87	0·84	0·81	0·78
800	691·0	0·98	0·96	0·95	0·93	0·92	0·90	0·89	0·88	0·86	0·83	0·80	0·77
900	682·0	0·96	0·95	0·93	0·92	0·90	0·88	0·88	0·86	0·84	0·82	0·79	0·75
1 000	674·0	0·95	0·93	0·92	0·90	0·89	0·87	0·86	0·85	0·83	0·80	0·77	0·74
1 100	666·0	0·93	0·92	0·91	0·89	0·87	0·86	0·85	0·84	0·81	0·79	0·76	0·73
1 200	658·0	0·92	0·91	0·89	0·88	0·86	0·84	0·84	0·82	0·80	0·78	0·75	0·71
1 300	650·0	0·91	0·89	0·88	0·86	0·85	0·83	0·82	0·81	0·79	0·76	0·73	0·70
1 400	642·0	0·89	0·88	0·86	0·85	0·83	0·82	0·81	0·80	0·77	0·75	0·72	0·69
1 500	634·0	0·88	0·86	0·85	0·84	0·82	0·80	0·80	0·78	0·76	0·74	0·71	0·67
1 600	626·0	0·86	0·85	0·84	0·82	0·81	0·79	0·78	0·77	0·75	0·72	0·69	0·66
1 700	618·0	0·85	0·84	0·82	0·81	0·79	0·78	0·77	0·76	0·73	0·71	0·68	0·65
1 800	611·0	0·84	0·82	0·81	0·80	0·78	0·77	0·76	0·75	0·72	0·70	0·67	0·64
1 900	600·0	0·82	0·80	0·79	0·78	0·76	0·75	0·74	0·73	0·71	0·68	0·65	0·62
2 000	595·0	0·81	0·80	0·78	0·77	0·76	0·74	0·73	0·72	0·70	0·67	0·65	0·61
2 100	589·0	0·80	0·79	0·77	0·76	0·74	0·73	0·72	0·71	0·69	0·66	0·63	0·60
2 200	582·0	0·79	0·77	0·76	0·75	0·73	0·72	0·71	0·70	0·68	0·65	0·62	0·59
2 300	574·0	0·77	0·76	0·75	0·73	0·72	0·70	0·69	0·68	0·66	0·64	0·61	0·58
2 400	567·0	0·76	0·75	0·73	0·72	0·71	0·69	0·68	0·67	0·65	0·63	0·60	0·57
2 500	560·0	0·75	0·74	0·72	0·71	0·69	0·68	0·67	0·66	0·64	0·62	0·59	0·56
2 600	553·0	0·73	0·72	0·71	0·70	0·68	0·67	0·66	0·65	0·63	0·60	0·57	0·54
2 700	546·0	0·72	0·71	0·70	0·69	0·67	0·66	0·65	0·64	0·62	0·59	0·56	0·53
2 800	539·0	0·71	0·70	0·69	0·67	0·66	0·64	0·64	0·63	0·60	0·58	0·55	0·52
2 900	532·0	0·70	0·69	0·67	0·66	0·65	0·63	0·62	0·61	0·59	0·57	0·54	0·51
3 000	526·0	0·69	0·68	0·66	0·65	0·64	0·62	0·61	0·60	0·58	0·56	0·53	0·50
3 100	519·0	0·67	0·66	0·65	0·64	0·62	0·61	0·60	0·59	0·57	0·55	0·52	0·49
3 200	513·0	0·66	0·65	0·64	0·63	0·61	0·60	0·59	0·58	0·56	0·54	0·51	0·48
3 300	506·0	0·65	0·64	0·63	0·62	0·60	0·59	0·58	0·57	0·55	0·53	0·50	0·47
3 400	500·0	0·64	0·63	0·62	0·61	0·59	0·58	0·57	0·56	0·54	0·52	0·49	0·46
3 500	493·0	0·63	0·62	0·61	0·59	0·58	0·57	0·56	0·55	0·53	0·50	0·48	0·45
3 600	487·0	0·62	0·61	0·60	0·58	0·57	0·56	0·55	0·54	0·52	0·50	0·47	0·44
3 700	481·0	0·61	0·60	0·59	0·57	0·56	0·55	0·54	0·53	0·51	0·49	0·46	0·43
3 800	474·0	0·60	0·58	0·57	0·56	0·55	0·53	0·53	0·52	0·50	0·47	0·45	0·41
3 900	468·0	0·58	0·57	0·56	0·55	0·54	0·52	0·52	0·51	0·49	0·46	0·44	0·41
4 000	462·0	0·57	0·56	0·55	0·54	0·53	0·51	0·51	0·50	0·48	0·45	0·43	0·40
4 100	456·0	0·56	0·55	0·54	0·53	0·52	0·50	0·50	0·49	0·47	0·44	0·42	0·39
4 200	451·0	0·55	0·54	0·53	0·52	0·51	0·50	0·49	0·48	0·46	0·44	0·41	0·38
4 300	445·0	0·54	0·53	0·52	0·51	0·50	0·49	0·48	0·47	0·45	0·43	0·40	0·37
4 400	439·0	0·53	0·52	0·51	0·50	0·49	0·48	0·47	0·46	0·44	0·42	0·39	0·36
4 500	433·0	0·52	0·51	0·50	0·49	0·48	0·47	0·46	0·45	0·43	0·41	0·38	0·35
4 600	427·0	0·51	0·50	0·49	0·48	0·47	0·46	0·45	0·44	0·42	0·40	0·37	0·34
4 700	421·0	0·50	0·49	0·48	0·47	0·46	0·44	0·44	0·43	0·41	0·39	0·36	0·33
4 800	415·0	0·49	0·48	0·47	0·46	0·45	0·43	0·43	0·42	0·40	0·38	0·35	0·32
4 900	410·0	0·48	0·47	0·46	0·45	0·44	0·43	0·42	0·41	0·39	0·37	0·34	0·31
5 000	405·0	0·47	0·46	0·45	0·44	0·43	0·42	0·41	0·40	0·38	0·36	0·33	0·30

Standard reference conditions { Mean barometric pressure = 100 kPa (750 mm of mercury)
Intake air temperature 300 K (27 °C)
Relative humidity = 90 percent at 300 K

(Continued)

APPENDIX E

POWER CORRECTION ADJUSTMENT FACTOR ALPHA (α) FOR NON-TURBOCHARGED CONSTANT SPEED ENGINES THE PERFORMANCE OF WHICH IS LIMITED BY AIR EXCESS FOR 75 PERCENT MECHANICAL EFFICIENCY — *Contd*

Height Above Sea Level	Air Pressure	Temperature of Inlet Air (Celsius) at 100 Percent Relative Humidity											
m	mm-Hg	0	5	10	15	20	25	27	30	35	40	45	50
0	760·0	1·10	1·08	1·07	1·05	1·03	1·01	1·00	0·98	0·96	0·93	0·89	0·85
100	751·0	1·08	1·07	1·05	1·03	1·01	0·99	0·98	0·97	0·94	0·91	0·87	0·83
200	742·0	1·07	1·05	1·03	1·02	1·00	0·98	0·97	0·95	0·93	0·90	0·86	0·82
300	733·0	1·05	1·03	1·02	1·00	0·98	0·96	0·95	0·94	0·91	0·88	0·85	0·80
400	725·0	1·04	1·02	1·01	0·99	0·97	0·95	0·94	0·93	0·90	0·87	0·83	0·79
500	716·0	1·02	1·00	0·99	0·97	0·95	0·93	0·92	0·91	0·88	0·85	0·82	0·78
600	708·0	1·01	0·99	0·98	0·96	0·94	0·92	0·91	0·90	0·87	0·84	0·80	0·78
700	699·0	0·99	0·97	0·96	0·94	0·93	0·90	0·90	0·88	0·86	0·83	0·79	0·75
800	691·0	0·98	0·96	0·95	0·93	0·91	0·89	0·88	0·87	0·84	0·81	0·78	0·74
900	682·0	0·96	0·95	0·93	0·91	0·90	0·88	0·87	0·85	0·83	0·80	0·76	0·72
1 000	674·0	0·95	0·93	0·92	0·90	0·88	0·86	0·85	0·84	0·81	0·78	0·75	0·71
1 100	666·0	0·93	0·92	0·90	0·89	0·87	0·85	0·84	0·83	0·80	0·77	0·74	0·70
1 200	658·0	0·92	0·90	0·89	0·87	0·86	0·84	0·83	0·81	0·79	0·76	0·72	0·68
1 300	650·0	0·90	0·89	0·88	0·86	0·84	0·82	0·81	0·80	0·77	0·74	0·71	0·67
1 400	642·0	0·89	0·88	0·86	0·85	0·83	0·81	0·80	0·79	0·76	0·73	0·70	0·66
1 500	634·0	0·88	0·86	0·85	0·83	0·82	0·80	0·79	0·77	0·75	0·72	0·68	0·64
1 600	626·0	0·86	0·85	0·83	0·82	0·80	0·78	0·77	0·76	0·73	0·71	0·67	0·63
1 700	618·0	0·85	0·83	0·82	0·80	0·79	0·77	0·76	0·75	0·72	0·69	0·66	0·62
1 800	611·0	0·83	0·82	0·81	0·79	0·78	0·76	0·75	0·74	0·71	0·68	0·65	0·61
1 900	600·0	0·82	0·80	0·79	0·77	0·76	0·74	0·73	0·72	0·69	0·66	0·63	0·59
2 000	596·0	0·81	0·80	0·78	0·77	0·75	0·73	0·72	0·71	0·68	0·66	0·62	0·58
2 100	589·0	0·80	0·78	0·77	0·75	0·74	0.72	0·71	0·70	0·67	0·64	0·61	0·57
2 200	582·0	0·78	0·77	0·76	0·74	0·73	0·71	0·70	0·69	0·66	0·63	0·60	0·56
2 300	574·0	0·77	0·76	0·74	0·73	0·71	0·69	0·69	0·67	0·65	0·62	0·59	0·55
2 400	567·0	0·76	0·74	0·73	0·72	0·70	0·68	0·67	0·66	0·64	0·61	0·57	0·54
2 500	560·0	0·75	0·73	0·72	0·71	0·69	0·67	0·66	0·65	0·63	0·60	0·56	0·52
2 600	553·0	0·73	0·72	0·71	0·69	0·68	0·66	0·65	0·64	0·61	0·59	0·55	0·51
2 700	546·0	0·72	0·71	0·70	0·68	0·67	0·65	0·64	0·63	0·60	0·57	0·54	0·50
2 800	539·0	0·71	0·70	0·68	0·67	0·65	0·63	0·63	0·62	0·59	0·56	0·53	0·49
2 900	532·0	0·70	0·68	0·67	0·66	0·64	0·62	0·62	0·60	0·58	0·55	0·52	0·48
3 000	526·0	0·69	0·67	0·66	0·65	0·63	0·61	0·61	0·59	0·57	0·54	0·51	0·47
3 100	519·0	0·67	0·66	0·65	0·63	0·62	0·60	0·59	0·58	0·56	0·53	0·50	0·46
3 200	513·0	0·66	0·65	0·64	0·62	0·61	0·59	0·58	0·57	0·55	0·52	0·49	0·45
3 300	506·0	0·65	0·64	0·63	0·61	0·60	0·58	0·57	0·56	0·54	0·51	0·47	0·44
3 400	500·0	0·64	0·63	0·62	0·60	0·59	0·57	0·56	0·55	0·53	0·50	0·47	0·43
3 500	493·0	0·63	0·62	0·60	0·59	0·58	0·56	0·55	0·54	0·51	0·49	0·45	0·42
3 600	487·0	0·62	0·60	0·59	0·58	0·57	0·55	0·54	0·53	0·50	0·48	0·44	0·41
3 700	481·0	0·61	0·59	0·58	0·57	0·56	0·54	0·53	0·52	0·49	0·47	0·43	0·40
3 800	474·0	0·59	0·58	0·57	0·56	0·54	0·53	0·52	0·51	0·49	0·46	0·42	0·38
3 900	468·0	0·58	0·57	0·56	0·55	0·53	0·52	0·51	0·50	0·47	0·45	0·41	0·38
4 000	462·0	0·57	0·56	0·55	0·54	0·52	0·51	0·50	0·49	0·46	0·44	0·40	0·37
4 100	456·0	0·56	0·55	0·54	0·53	0·51	0·49	0·49	0·48	0·45	0·43	0·39	0·36
4 230	451·0	0·55	0·54	0·53	0·52	0·50	0·49	0·48	0·47	0·44	0·42	0·39	0·35
4 300	445·0	0·54	0·53	0·52	0·51	0·49	0·48	0·47	0·46	0·43	0·41	0·38	0·34
4 400	439·0	0·53	0·52	0·51	0·50	0·48	0·47	0·46	0·45	0·42	0·40	0·37	0·33
4 500	433·0	0·52	0·51	0·50	0·49	0·47	0·46	0·45	0·44	0·41	0·39	0·36	0·32
4 600	427·0	0·51	0·50	0·49	0·48	0·46	0·45	0·44	0·43	0·40	0·38	0·35	0·31
4 700	421·0	0·50	0·49	0·48	0·47	0·45	0·44	0·43	0·42	0·39	0·37	0·34	0·30
4 800	415·0	0·49	0·48	0·47	0·46	0·44	0·43	0·42	0·41	0·38	0·36	0·33	0·29
4 900	410·0	0·48	0·47	0·46	0·45	0·43	0·42	0·41	0·40	0·38	0·35	0 32	0·28
5 000	405·0	0·47	0·46	0·45	0·44	0·43	0·41	0·40	0·39	0·37	0·34	0·31	0·27

Standard reference conditions { Mean barometric pressure = 100 kPa (750 mm of mercury)
Intake air temperature 300 K (27° C)
Relative humidity = 60 percent at 300 K

(*Continued*)

APPENDIX E

POWER CORRECTION ADJUSTMENT FACTOR ALPHA (α) FOR NON-TURBOCHARGED CONSTANT SPEED ENGINES THE PERFORMANCE OF WHICH IS LIMITED BY AIR EXCESS FOR 80 PERCENT MECHANICAL EFFICIENCY — *Contd*

Height Above Sea Level	Air Pressure	Temperature of Inlet Air (Celsius) at 60 Percent Relative Humidity											
m	mm-Hg	0	5	10	15	20	25	27	30	35	40	45	50
0	760·0	1·10	1·08	1·07	1·05	1·04	1·02	1·02	1·01	0·99	0·96	0·94	0·91
100	751·0	1·08	1·07	1·05	1·04	1·02	1·01	1·00	0·99	0·98	0·95	0·93	0·90
200	742·0	1·07	1·05	1·04	1·03	1·01	0·99	0·99	0·98	0·96	0·94	0·91	0·88
300	733·0	1·05	1·04	1·02	1·01	1·00	0·98	0·97	0·96	0·95	0·92	0·90	0·87
400	725·0	1·04	1·02	1·01	1·00	0·98	0·97	0·96	0·95	0·93	0·91	0·88	0·86
500	716·0	1·02	1·01	1·00	0·98	0·97	0·95	0·95	0·94	0·92	0·90	0·87	0·84
600	708·0	1·01	1·00	0·98	0·97	0·95	0·94	0·93	0·92	0·91	0·88	0·86	0·83
700	699·0	0·99	0·98	0·97	0·96	0·94	0·92	0·92	0·91	0·89	0·87	0·84	0·82
800	691·0	0·98	0·97	0·96	0·94	0·93	0·91	0·91	0·90	0·88	0·86	0·83	0·81
900	682·0	0·96	0·95	0·94	0·93	0·91	0·90	0·89	0·88	0·87	0·84	0·82	0·79
1 000	674·0	0·95	0·94	0·93	0·91	0·90	0·88	0·88	0·87	0·85	0·83	0·81	0·78
1 100	666·0	0·94	0·93	0·91	0·90	0·89	0·87	0·87	0·86	0·84	0·82	0·79	0·77
1 200	658·0	0·92	0·91	0·90	0·89	0·87	0·86	0·85	0·84	0·83	0·80	0·78	0·75
1 300	650·0	0·91	0·90	0·89	0·87	0·86	0·85	0·84	0·83	0·82	0·79	0·77	0·74
1 400	642·0	0·90	0·89	0·87	0·86	0·85	0·83	0·83	0·82	0·80	0·78	0·76	0·73
1 500	634·0	0·88	0·87	0·86	0·85	0·83	0·82	0·81	0·81	0·79	0·77	0·74	0·72
1 600	626·0	0·87	0·86	0·85	0·84	0·82	0·81	0·80	0·79	0·78	0·75	0·73	0·71
1 700	618·0	0·86	0·85	0·83	0·82	0·81	0·79	0·79	0·78	0·77	0·74	0·72	0·69
1 800	611·0	0·85	0·83	0·82	0·81	0·80	0·78	0·78	0·77	0·75	0·73	0·71	0·68
1 900	603·0	0·83	0·82	0·81	0·79	0·78	0·77	0·76	0·75	0·74	0·71	0·69	0·67
2 000	596·0	0·82	0·81	0·80	0·79	0·77	0·76	0·75	0·74	0·73	0·71	0·68	0·66
2 100	589·0	0·81	0·80	0·79	0·78	0·76	0·75	0·74	0·73	0·72	0·70	0·67	0·65
2 200	582·0	0·80	0·79	0·78	0·76	0·75	0·74	0·73	0·72	0·71	0·69	0·66	0·64
2 300	574·0	0·78	0·77	0·76	0·75	0·74	0·72	0·72	0·71	0·70	0·67	0·65	0·63
2 400	567·0	0·77	0·76	0·75	0·74	0·73	0·71	0·71	0·70	0·68	0·66	0·64	0·61
2 500	560·0	0·76	0·75	0·74	0·73	0·72	0·70	0·70	0·69	0·67	0·65	0·63	0·60
2 600	553·0	0·75	0·74	0·73	0·72	0·70	0·69	0·69	0·68	0·66	0·64	0·62	0·59
2 700	546·0	0·74	0·73	0·72	0·70	0·69	0·68	0·67	0·66	0·65	0·63	0·61	0·58
2 800	539·0	0·72	0·72	0·70	0·69	0·68	0·67	0·66	0·65	0·64	0·62	0·60	0·57
2 900	532·0	0·71	0·70	0·69	0·68	0·67	0·66	0·65	0·64	0·63	0·61	0·59	0·56
3 000	526·0	0·70	0·69	0·68	0·67	0·66	0·65	0·64	0·63	0·62	0·60	0·58	0·55
3 100	519·0	0·69	0·68	0·67	0·66	0·65	0·64	0·63	0·62	0·61	0·59	0·56	0·54
3 200	513·0	0·68	0·67	0·66	0·65	0·64	0·63	0·62	0·61	0·60	0·58	0·56	0·53
3 300	506·0	0·67	0·66	0·65	0·64	0·63	0·61	0·61	0·60	0·59	0·57	0·54	0·52
3 400	500·0	0·66	0·65	0·64	0·63	0·62	0·61	0·60	0·59	0·58	0·56	0·53	0·51
3 500	493·0	0·65	0·64	0·63	0·62	0·61	0·59	0·59	0·58	0·57	0·55	0·52	0·50
3 600	487·0	0·64	0·63	0·62	0·61	0·60	0·58	0·58	0·57	0·56	0·54	0·51	0·49
3 700	481·0	0·63	0·62	0·61	0·60	0·59	0·57	0·57	0·56	0·55	0·53	0·51	0·48
3 800	474·0	0·62	0·61	0·60	0·59	0·58	0·56	0·56	0·55	0·54	0·52	0·49	0·47
3 900	468·0	0·61	0·60	0·59	0·58	0·57	0·55	0·55	0·54	0·53	0·51	0·49	0·46
4 000	462·0	0·60	0·59	0·58	0·57	0·56	0·54	0·54	0·53	0·52	0·50	0·48	0·45
4 100	456·0	0·59	0·58	0·57	0·56	0·55	0·53	0·53	0·52	0·51	0·49	0·47	0·44
4 200	451·0	0·58	0·57	0·56	0·55	0·54	0·53	0·52	0·51	0·50	0·48	0·46	0·44
4 300	445·0	0·57	0·56	0·55	0·54	0·53	0·52	0·51	0·50	0·49	0·47	0·45	0·43
4 400	439·0	0·56	0·55	0·54	0·53	0·52	0·51	0·50	0·49	0·48	0·46	0·44	0·42
4 500	433·0	0·55	0·54	0·53	0·52	0·51	0·50	0·49	0·48	0·47	0·45	0·43	0·41
4 600	427·0	0·54	0·53	0·52	0·51	0·50	0·49	0·48	0·48	0·46	0·44	0·42	0·40
4 700	421·0	0·53	0·52	0·51	0·50	0·49	0·48	0·47	0·47	0·45	0·43	0·41	0·39
4 800	415·0	0·52	0·51	0·50	0·49	0·48	0·47	0·46	0·46	0·44	0·42	0·40	0·38
4 900	410·0	0·51	0·50	0·49	0·48	0·47	0·46	0·46	0·45	0·44	0·42	0·39	0·37
5 000	405·0	0·50	0·49	0·48	0·47	0·46	0·45	0·45	0·44	0·43	0·41	0·39	0·36

Standard reference conditions { Mean barometric pressure = 100 kPa (750 mm of mercury)
Intake air temperature 300 K (27 °C)
Relative humidity = 60 percent at 300 K

(*Continued*)

APPENDIX E

POWER CORRECTION ADJUSTMENT FACTOR ALPHA (α) FOR NON-TURBOCHARGED CONSTANT SPEED ENGINES THE PERFORMANCE OF WHICH IS LIMITED BY AIR EXCESS FOR 80 PERCENT MECHANICAL EFFICIENCY — *Contd*

Height Above Sea Level	Air Pressure	Temperature of Inlet Air (Celsius) at 80 Percent Relative Humidity											
m	mm-Hg	0	5	10	15	20	25	27	30	35	40	45	50
0	760·0	1·09	1·08	1·07	1·05	1·03	1·02	1 01	0 99	0·97	0·95	0·92	0·88
100	751·0	1·08	1·07	1·05	1·03	1·02	1·00	0·99	0·98	0·96	0·93	0·90	0·87
200	742·0	1·06	1·05	1·04	1·02	1·00	0·99	0·98	0·97	0·94	0·92	0·89	0·86
300	733·0	1·05	1·04	1·02	1·01	0·99	0·97	0·96	0·95	0·93	0·90	0·87	0·84
400	725·0	1·04	1·02	1·01	0·99	0·98	0·96	0·95	0·94	0·92	0·89	0 86	0·83
500	716·0	1·02	1·01	0·99	0·98	0·96	0·94	0·94	0·92	0·90	0·88	0·85	0·82
600	708·0	1·01	0·99	0·98	0·96	0·95	0·93	0·92	0·91	0·89	0·87	0·84	0·80
700	699·0	0·99	0·98	0·96	0·95	0·93	0·92	0·91	0·90	0·88	0·85	0·82	0·79
800	691·0	0·98	0·97	0·95	0·94	0·92	0·90	0·90	0·89	0·86	0·84	0·81	0·78
900	682·0	0·96	0·95	0·94	0·92	0·91	0·89	0·88	0·87	0·85	0 82	0·80	0·76
1 000	674·0	0·95	0·94	0·92	0·91	0·89	0·88	0·87	0·86	0·84	0·81	0·78	0·75
1 100	666·0	0·94	0·92	0·91	0·90	0·88	0·86	0·86	0·85	0·82	0·80	0·77	0·74
1 200	658·0	0·92	0·91	0·90	0·88	0·87	0·85	0·84	0·83	0·81	0·79	0·76	0·73
1 300	650·0	0·91	0·90	0·88	0·87	0·85	0·84	0·83	0·82	0·80	0·77	0·75	0·71
1 400	642·0	0·90	0·88	0·87	0·86	0·84	0·83	0·82	0·81	0·79	0·76	0·73	0·70
1 500	634·0	0·88	0·87	0·86	0·84	0·83	0·81	0·81	0·79	0·77	0·75	0·72	0·69
1 600	626·0	0·87	0·86	0·84	0·83	0·82	0·80	0·79	0·78	0·76	0·74	0·71	0·68
1 700	618·0	0·86	0·84	0·83	0·82	0·80	0·79	0·78	0·77	0·75	0·72	0·70	0·66
1 800	611·0	0·84	0·83	0·82	0·81	0·79	0·78	0·77	0·76	0·74	0·71	0·69	0·65
1 900	600·0	0·83	0·81	0·80	0·79	0·77	0·76	0·75	0·74	0·72	0·70	0·67	0·64
2 000	596·0	0·82	0·81	0·79	0·78	0·77	0·75	0·74	0·73	0·71	0·69	0·66	0·63
2 100	589·0	0·81	0·80	0·78	0·77	0·76	0·74	0·73	0·72	0·70	0·68	0·65	0·62
2 200	582·0	0·80	0·78	0·77	0·76	0·74	0·73	0·72	0·71	0·69	0·67	0·64	0·61
2 300	574·0	0·78	0·77	0·76	0·75	0·73	0·72	0·71	0·70	0·68	0·66	0·63	0·60
2 400	567·0	0·77	0·76	0·75	0·73	0·72	0·71	0·70	0·69	0·67	0·64	0·62	0·59
2 500	560·0	0·76	0·75	0·74	0·72	0·71	0·69	0·69	0·68	0·66	0·63	0·61	0·58
2 600	553·0	0·75	0·74	0·72	0·71	0·70	0·68	0·68	0·67	0·64	0·62	0·60	0·56
2 700	546·0	0·74	0·72	0·71	0·70	0·69	0·67	0·63	0·65	0·63	0 61	0·58	0·55
2 800	539·0	0·72	0·71	0·70	0·69	0·68	0·66	0·65	0·64	0·62	0 60	0·57	0·54
2 900	532·0	0·71	0·70	0·69	0·66	0·66	0·65	0·64	0·63	0·61	0·59	0·56	0·53
3 000	526·0	0·70	0·69	0·68	0·67	0·65	0·64	0·63	0·62	0·60	0·58	0·55	0·52
3 100	519·0	0·69	0·68	0·67	0·66	0·64	0·63	0·62	0·61	0·59	0·57	0·54	0·51
3 200	513·0	0·68	0·67	0·66	0·65	0·63	0·62	0·61	0·60	0·58	0·56	0·53	0·50
3 300	506·0	0·67	0·66	0·65	0·63	0·62	0·61	0·60	0·59	0·57	0·55	0·52	0 49
3 400	500·0	0·66	0·65	0·64	0·62	0·61	0·60	0·59	0·58	0·56	0 54	0·51	0·48
3 500	493·0	0·65	0·64	0·63	0·61	0·60	0·59	0·58	0·57	0·55	0·53	0·50	0·47
3 600	487·0	0·64	0·63	0·62	0·60	0·59	0·58	0·57	0·56	0·54	0·52	0·49	0·46
3 700	481·0	0·63	0·62	0·61	0·59	0·58	0·57	0·56	0·55	0·53	0·51	0·48	0·45
3 800	474·0	0·61	0·60	0·59	0·58	0·57	0·56	0·55	0·54	0·52	0·50	0·47	0·44
3 900	468·0	0·60	0·59	0·58	0·57	0·56	0·55	0·54	0·53	0·51	0·49	0·46	0·43
4 000	462·0	0·59	0·58	0·57	0·56	0·55	0·54	0·53	0·52	0·50	0·48	0·45	0·42
4 100	456·0	0·58	0·57	0·56	0·55	0·54	0·53	0·52	0·51	0·49	0·47	0·44	0·41
4 200	451·0	0·58	0·57	0·56	0·54	0·53	0·52	0·51	0·50	0·48	0·46	0·44	0·41
4 300	445·0	0·57	0·56	0·55	0·53	0·52	0·51	0·50	0·49	0·47	0·45	0·43	0·40
4 400	439·0	0·56	0·55	0·54	0·53	0·51	0·50	0·49	0·48	0·46	0·44	0·42	0·39
4 500	433·0	0·55	0·54	0·53	0·52	0·50	0·49	0·48	0·47	0·46	0·43	0·41	0·38
4 600	427·0	0·54	0·53	0·52	0·51	0·49	0·48	0·47	0·46	0·45	0·42	0·40	0·37
4 700	421·0	0·53	0·52	0·51	0·50	0·48	0·47	0·46	0·45	0·44	0·42	0·39	0·36
4 800	415·0	0·52	0·51	0·50	0·49	0·47	0·46	0·45	0·45	0·43	0·41	0·38	0·35
4 900	410·0	0·51	0·50	0·49	0·48	0·47	0·45	0·45	0·44	0·42	0·40	0·37	0·34
5 000	405·0	0·50	0·49	0·48	0·47	0·46	0·45	0·44	0·43	0·41	0·39	0·36	0·34

Standard reference conditions { Mean barometric pressure = 100 kPa (750 mm of mercury)
Intake air temperature 300 K (27 °C)
Relative humidity = 60 percent at 300 K

(*Continued*)

APPENDIX E

POWER CORRECTION ADJUSTMENT FACTOR ALPHA (α) FOR NON-TURBOCHARGED CONSTANT SPEED ENGINES THE PERFORMANCE OF WHICH IS LIMITED BY AIR EXCESS FOR 80 PERCENT MECHANICAL EFFICIENCY — *Contd*

Height Above Sea Level	Air Pressure	Temperature of Inlet Air (Celsius) at 100 Percent Relative Humidity											
m	mm-Hg	0	5	10	15	20	25	27	30	35	40	45	50
0	760·0	1·09	1·08	1·06	1·05	1·03	1·01	1·00	0·99	0·96	0·93	0·89	0·86
100	751·0	1·08	1·06	1·05	1·03	1·01	0·99	0·98	0·97	0·94	0·91	0·88	0·84
200	742·0	1·06	1·05	1·03	1·02	1·00	0·98	0·97	0·96	0·93	0·90	0·87	0·83
300	733·0	1·05	1·03	1·02	1·00	0·98	0·96	0·96	0·94	0·92	0·89	0·85	0·81
400	725·0	1·03	1·02	1·01	0·99	0·97	0·95	0·94	0·93	0·90	0·87	0·84	0·80
500	716·0	1·02	1·00	0·99	0·97	0·96	0·94	0·93	0·92	0·89	0·86	0·83	0·79
600	708·0	1·01	0·99	0·98	0·96	0·94	0·92	0·92	0·90	0·88	0·85	0·81	0·77
700	699·0	0·99	0·98	0·96	0·95	0·93	0·91	0·90	0·89	0·86	0·83	0·80	0·76
800	691·0	0·98	0·96	0·95	0·93	0·92	0·90	0·89	0·88	0·85	0·82	0·79	0·75
900	682·0	0·96	0·95	0·93	0·92	0·90	0·88	0·87	0·86	0·84	0·81	0·77	0·73
1 000	674·0	0·95	0·93	0·92	0·91	0·89	0·87	0·86	0·85	0·82	0·79	0·76	0·72
1 100	666·0	0·94	0·92	0·91	0·89	0·88	0·86	0·85	0·84	0·81	0·78	0·75	0·71
1 200	658·0	0·92	0·91	0·89	0·88	0·86	0·84	0·84	0·82	0·80	0·77	0·74	0·70
1 300	650·0	0·91	0·89	0·88	0·87	0·85	0·83	0·82	0·81	0·78	0·76	0·72	0 69
1 400	642·0	0·89	0·88	0·87	0·85	0·84	0·82	0·81	0·80	0·77	0·74	0·71	0·67
1 500	634·0	0·88	0·87	0·86	0·84	0·82	0·80	0·80	0·78	0·76	0·73	0·70	0·66
1 600	626·0	0·87	0·85	0·84	0·83	0·81	0·79	0·78	0·77	0·75	0·72	0·69	0·65
1 700	618·0	0·85	0·84	0·83	0·81	0·80	0·78	0·77	0·76	0·73	0·71	0·67	0·64
1 800	611·0	0·84	0·83	0·82	0·80	0·79	0·77	0·76	0·75	0·72	0·70	0·66	0·63
1 900	600·0	0·82	0·81	0·80	0·78	0·77	0·75	0·74	0·73	0·71	0·68	0·65	0·61
2 000	596·0	0·82	0·80	0·79	0·78	0·76	0·74	0·74	0·72	0·70	0·67	0·64	0·60
2 100	589·0	0·81	0·79	0·78	0·77	0·75	0·73	0·72	0·71	0·69	0·66	0·63	0·59
2 200	582·0	0·79	0·78	0·77	0·76	0·74	0·72	0·71	0·70	0·68	0·65	0·62	0·58
2 300	574·0	0·78	0·77	0·76	0·74	0·73	0·71	0·70	0·69	0·66	0·64	0·61	0·57
2 400	567·0	0·77	0·76	0·74	0·73	0·72	0·70	0·69	0·68	0·65	0·63	0·59	0·56
2 500	560·0	0·76	0·75	0·73	0·72	0·70	0·69	0·68	0·67	0·64	0·62	0·58	0·55
2 600	553·0	0·75	0·73	0·72	0·71	0·69	0·67	0·67	0·66	0·63	0·60	0·57	0·54
2 700	546·0	0·73	0·72	0·71	0·70	0·68	0·66	0·66	0·64	0·62	0·59	0·56	0·53
2 800	539·0	0·72	0·71	0·70	0·68	0·67	0·65	0·64	0·63	0·61	0·58	0·55	0·51
2 900	532·0	0·71	0·70	0·69	0·67	0·66	0·64	0·63	0·62	0·60	0·57	0·54	0·50
3 000	526·0	0·70	0·69	0·68	0 66	0·65	0·63	0·62	0·61	0·59	0·56	0·53	0·49
3 100	519·0	0·69	0·68	0·67	0·65	0·64	0·62	0·61	0·60	0·58	0·55	0·52	0·48
3 200	513·0	0·68	0·67	0·66	0·64	0·63	0·61	0·60	0·59	0·57	0·54	0·51	0·47
3 300	506·0	0·67	0·66	0·64	0·63	0·62	0·60	0·59	0·58	0·56	0·53	0·50	0·46
3 400	500·0	0·66	0·65	0·63	0·62	0·61	0·59	0·58	0·57	0·55	0·52	0·49	0·45
3 500	493·0	0·64	0·63	0·62	0·61	0·60	0·58	0·57	0·56	0·54	0·51	0·48	0·44
3 600	487·0	0·63	0·62	0·61	0·60	0·59	0·57	0·56	0·55	0·53	0·50	0·47	0·43
3 700	481·0	0·62	0·61	0·60	0·59	0·58	0·56	0·55	0·54	0·52	0·49	0·46	0·42
3 800	474·0	0·61	0·60	0·59	0·58	0·56	0·55	0·54	0·53	0·51	0·48	0·45	0·41
3 900	468·0	0·60	0·59	0·58	0·57	0·56	0·54	0·53	0 52	0·50	0·47	0·44	0·40
4 000	462·0	0·59	0·58	0·57	0·56	0·55	0·53	0·52	0·51	0·49	0·46	0·43	0·40
4 100	456·0	0·58	0·57	0·56	0·55	0·54	0·52	0·51	0·50	0·48	0·45	0·42	0·39
4 200	451·0	0·57	0·56	0·55	0 54	0·53	0·51	0·50	0·49	0·47	0·44	0·41	0·38
4 300	445·0	0·56	0·55	0·54	0·53	0·52	0·50	0·49	0·48	0·46	0·44	0·40	0·37
4 400	439·0	0·55	0·54	0·53	0·52	0·51	0·49	0·48	0·47	0·45	0·43	0·40	0·36
4 500	433·0	0·54	0·53	0·52	0·51	0·50	0·48	0·47	0·46	0·44	0·42	0·39	0·35
4 600	427·0	0·53	0·52	0·51	0·50	0·49	0·47	0·47	0·45	0·43	0·41	0·38	0·34
4 700	421·0	0·52	0·51	0·50	0·49	0·48	0·46	0·46	0·45	0·42	0·40	0·37	0·33
4 800	415·0	0·51	0·50	0·49	0·48	0·47	0·45	0·45	0·44	0·41	0·39	0·36	0·32
4 900	410·0	0·51	0·50	0·49	0·47	0·46	0·44	0·44	0·43	0·41	0·38	0 35	0·32
5 000	405·0	0·50	0·49	0·48	0·47	0·45	0·44	0·43	0·42	0·40	0·37	0·34	0·31

Standard reference conditions { Mean barometric pressure = 100 kPa (750 mm of mercury)
Intake air temperature 300 K (27° C)
Relative humidity = 60 percent at 300 K

(*Continued*)

APPENDIX E

POWER CORRECTION ADJUSTMENT FACTOR ALPHA (α) FOR NON-TURBOCHARGED CONSTANT SPEED ENGINES THE PERFORMANCE OF WHICH IS LIMITED BY AIR EXCESS FOR 85 PERCENT MECHANICAL EFFICIENCY — *Contd*

Height Above Sea Level	Air Pressure	Temperature of Inlet Air (Celsius) at 60 Percent Relative Humidity											
m	mm-Hg	0	5	10	15	20	25	27	30	35	40	45	50
0	760·0	1·09	1·08	1·07	1·05	1·04	1·02	1·02	1·01	0·99	0·97	0·94	0·92
100	751·0	1·08	1·08	1·05	1·04	1·02	1·01	1·00	0·99	0·98	0·95	0·93	0·90
200	742·0	1·06	1·05	1·04	1·02	1·01	0·99	0·99	0·98	0·96	0·94	0·92	0·89
300	733·0	1·05	1·04	1·02	1·01	1·00	0·98	0·97	0·96	0·95	0·93	0·90	0·88
400	725·0	1·04	1·02	1·01	1·00	0·98	0·97	0·96	0·95	0·94	0·91	0·89	0·86
500	716·0	1·02	1·01	1·00	0·98	0·97	0·95	0·95	0·94	0·92	0·90	0·88	0·85
600	708·0	1·01	1·00	0·98	0·97	0·96	0·94	0·94	0·93	0·91	0·89	0·86	0·84
700	699·0	0·99	0·98	0·97	0·96	0·94	0·93	0·92	0·91	0·90	0·87	0·85	0·83
800	691·0	0·98	0·97	0·96	0·94	0·93	0·92	0·91	0·90	0·89	0·86	0·84	0·81
900	682·0	0·97	0·95	0·94	0·93	0·92	0·90	0·90	0·89	0·87	0·85	0·83	0·80
1 000	674·0	0·95	0·94	0·93	0·92	0·90	0·89	0·88	0·87	0·86	0·84	0·81	0·79
1 100	666·0	0·94	0·93	0·92	0·91	0·89	0·88	0·87	0·86	0·85	0·83	0·80	0·78
1 200	658·0	0·93	0·92	0·91	0·89	0·88	0·87	0·86	0·85	0·84	0·81	0·79	0·77
1 300	650·0	0·91	0·90	0·89	0·88	0·87	0·85	0·85	0·84	0·82	0·80	0·78	0·75
1 400	642·0	0·90	0·89	0·88	0·87	0·85	0·84	0·84	0·83	0·81	0·79	0·77	0·74
1 500	634·0	0·89	0·88	0·87	0·86	0·84	0·83	0·82	0·81	0·80	0·78	0·75	0·73
1 600	626·0	0·88	0·87	0·85	0·84	0·83	0·82	0·81	0·80	0·79	0·77	0·74	0·72
1 700	618·0	0·86	0·85	0·84	0·83	0·82	0·80	0·80	0·79	0·78	0·75	0·73	0·71
1 800	611·0	0·85	0·84	0·83	0·82	0·81	0·79	0·79	0·78	0·76	0·74	0·72	0·70
1 900	600·0	0·83	0·82	0·81	0·80	0·79	0·78	0·77	0·76	0·75	0·73	0·70	0·68
2 000	596·0	0·83	0·82	0·81	0·80	0·78	0·77	0·76	0·76	0·74	0·72	0·70	0·67
2 100	589·0	0·82	0·81	0·80	0·78	0·77	0·76	0·75	0·75	0·73	0·71	0·69	0·66
2 200	582·0	0·81	0·80	0·79	0·77	0·76	0·75	0·74	0·73	0·72	0·70	0·68	0·65
2 300	574·0	0·79	0·78	0·77	0·76	0·75	0·74	0·73	0·72	0·71	0·69	0·67	0·64
2 400	567·0	0·78	0·77	0·76	0·75	0·74	0·73	0·72	0·71	0·70	0·68	0·65	0·63
2 500	560·0	0·77	0·76	0·75	0·74	0·73	0·71	0·71	0·70	0·69	0·67	0·64	0·62
2 600	553·0	0·76	0·75	0·74	0·73	0·72	0·70	0·70	0·69	0·68	0·66	0·63	0·61
2 700	546·0	0·75	0·74	0·73	0·72	0·71	0·69	0·69	0·68	0·67	0·65	0·62	0·60
2 800	539·0	0·74	0·73	0·72	0·71	0·70	0·68	0·68	0·67	0·66	0·63	0·61	0·59
2 900	532·0	0·73	0·72	0·71	0·70	0·68	0·67	0·67	0·66	0·65	0·62	0·60	0·58
3 000	526·0	0·72	0·71	0·70	0·69	0·67	0·66	0·66	0·65	0·64	0·62	0·59	0·57
3 100	519·0	0·70	0·70	0·69	0·68	0·66	0·65	0·65	0·64	0·63	0·60	0·58	0·56
3 200	513·0	0·69	0·69	0·68	0·67	0·65	0·64	0·64	0·63	0·62	0·60	0·57	0·55
3 300	506·0	0·68	0·68	0·67	0·66	0·64	0·63	0·63	0·62	0·61	0·59	0·56	0·54
3 400	500·0	0·67	0·67	0·66	0·65	0·63	0·62	0·62	0·61	0·60	0·58	0·56	0·53
3 500	493·0	0·66	0·65	0·65	0·63	0·62	0·61	0·61	0·60	0·59	0·57	0·54	0·52
3 600	487·0	0·65	0·64	0·64	0·63	0·61	0·60	0·60	0·59	0·58	0·56	0·54	0·51
3 700	481·0	0·64	0·64	0·63	0·62	0·61	0·59	0·59	0·58	0·57	0·55	0·53	0·50
3 800	474·0	0·63	0·62	0·62	0·61	0·59	0·58	0·58	0·57	0·56	0·54	0·52	0·49
3 900	468·0	0·62	0·61	0·61	0·60	0·59	0·57	0·57	0·56	0·55	0·53	0·51	0·49
4 000	462·0	0·61	0·61	0·60	0·59	0·58	0·56	0·56	0·55	0·54	0·52	0·50	0·48
4 100	456·0	0·60	0·60	0·59	0·58	0·57	0·55	0·55	0·54	0·53	0·51	0·49	0·47
4 200	451·0	0·60	0·59	0·58	0·57	0·56	0·55	0·54	0·53	0·52	0·50	0·48	0·46
4 300	445·0	0·59	0·58	0·57	0·56	0·55	0·54	0·53	0·53	0·51	0·49	0·47	0·45
4 400	439·0	0·58	0·57	0·56	0·55	0·54	0·53	0·52	0·52	0·51	0·48	0·46	0·44
4 500	433·0	0·57	0·56	0·55	0·54	0·53	0·52	0·52	0·51	0·50	0·48	0·46	0·43
4 600	427·0	0·56	0·55	0·54	0·53	0·52	0·51	0·51	0·50	0·49	0·47	0·45	0·42
4 700	421·0	0·55	0·54	0·53	0·52	0·51	0·50	0·50	0·49	0·48	0·46	0·44	0·42
4 800	415·0	0·54	0·53	0·52	0·51	0·50	0·49	0·49	0·48	0·47	0·45	0·43	0·41
4 900	410·0	0·53	0·52	0·51	0·51	0·50	0·48	0·48	0·47	0·46	0·44	0·42	0·40
5 000	405·0	0·52	0·51	0·51	0·50	0·49	0·48	0·47	0·46	0·45	0·43	0·41	0·39

Standard reference conditions { Mean barometric pressure = 100 kPa (750 mm of mercury)
Intake air temperature 300 K (27 °C)
Relative humidity = 60 percent at 300 K

(*Continued*)

APPENDIX E

POWER CORRECTION ADJUSTMENT FACTOR ALPHA (α) FOR NON-TURBOCHARGED CONSTANT SPEED ENGINES THE PERFORMANCE OF WHICH IS LIMITED BY AIR EXCESS FOR 85 PERCENT MECHANICAL EFFICIENCY — *Contd*

Height Above Sea Level	Air Pressure	Temperature of Inlet Air (Celsius) at 80 Percent Relative Humidity											
m	mm-Hg	0	5	10	15	20	25	27	30	35	40	45	50
0	760·0	1·09	1·08	1·06	1·05	1·03	1·01	1·01	1·00	0·97	0·95	0·92	0·89
100	751·0	1·08	1·06	1·05	1·03	1·02	1·00	0·99	0·98	0·96	0·94	0·91	0·88
200	742·0	1·06	1·05	1·03	1·02	1·00	0·99	0·98	0·97	0·95	0·92	0·89	0·86
300	733·0	1·05	1·03	1·02	1·01	0·99	0·97	0·97	0·95	0·93	0·91	0·88	0·85
400	725·0	1·03	1·02	1·01	0·99	0·98	0·96	0·95	0·94	0·92	0·90	0·87	0·84
500	716·0	1·02	1·01	0·99	0·98	0·96	0·95	0·94	0·93	0·91	0·88	0·86	0·82
600	708·0	1·01	0·99	0·98	0·97	0·95	0·94	0·93	0·92	0·89	0·87	0·84	0·81
700	699·0	0·99	0·98	0·97	0·95	0·94	0·92	0·91	0·90	0·88	0·86	0·83	0·80
800	691·0	0·98	0·97	0·95	0·94	0·92	0·91	0·90	0·89	0·87	0·85	0·82	0·79
900	682·0	0·96	0·95	0·94	0·93	0·91	0·90	0·89	0·88	0·86	0·83	0·80	0·77
1 000	674·0	0·95	0·94	0·93	0·91	0·90	0·88	0·87	0·86	0·84	0·82	0·79	0·76
1 100	666·0	0·94	0·93	0·91	0·90	0·89	0·87	0·86	0·85	0·83	0·81	0·78	0·75
1 200	658·0	0·93	0·91	0·90	0·89	0·87	0·86	0·85	0·84	0·82	0·80	0·77	0·74
1 300	650·0	0·91	0·90	0·89	0·88	0·86	0·85	0·84	0·83	0·81	0·78	0·76	0·73
1 400	642·0	0·90	0·89	0·88	0·86	0·85	0·83	0·83	0·82	0·79	0·77	0·75	0·71
1 500	634·0	0·89	0·88	0·86	0·85	0·84	0·82	0·81	0·80	0·78	0·76	0·73	0·70
1 600	626·0	0·87	0·86	0·85	0·84	0·82	0·81	0·80	0·79	0·77	0·75	0·72	0·69
1 700	618·0	0·86	0·85	0·84	0·83	0·81	0·80	0·79	0·78	0·76	0·74	0·71	0·68
1 800	611·0	0·85	0·84	0·83	0·81	0·80	0·79	0·78	0·77	0·75	0·73	0·70	0·67
1 900	600·0	0·83	0·82	0·81	0·80	0·78	0·77	0·76	0·75	0·73	0·71	0·68	0·65
2 000	596·0	0·83	0·82	0·80	0·79	0·78	0·76	0·76	0·75	0·73	0·70	0·68	0·65
2 100	589·0	0·82	0·80	0·79	0·78	0·77	0·75	0·74	0·73	0·71	0·69	0·67	0·64
2 200	582·0	0·80	0·79	0·78	0·77	0·76	0·74	0·73	0·72	0·70	0·68	0·66	0·63
2 300	574·0	0·79	0·78	0·77	0·76	0·74	0·73	0·72	0·71	0·69	0·67	0·64	0·61
2 400	567·0	0·78	0·77	0·76	0·75	0·73	0·72	0·71	0·70	0·68	0·66	0·63	0·60
2 500	560·0	0·77	0·76	0·75	0·73	0·72	0·71	0·70	0·69	0·67	0·65	0·62	0·59
2 600	553·0	0·76	0·75	0·74	0·72	0·71	0·70	0·69	0·68	0·66	0·64	0·61	0·58
2 700	546·0	0·75	0·74	0·73	0·71	0·70	0·69	0·68	0·67	0·65	0·63	0·60	0·57
2 800	539·0	0·74	0·73	0·71	0·70	0·69	0·68	0·67	0·66	0·64	0·62	0·59	0·56
2 900	532·0	0·72	0·71	0·70	0·69	0·68	0·66	0·66	0·65	0·63	0·61	0·58	0·55
3 000	526·0	0·71	0·70	0·69	0·68	0·67	0·66	0·65	0·64	0·62	0·60	0·57	0·54
3 100	519·0	0·70	0·69	0·68	0·67	0·66	0·64	0·64	0·63	0·61	0·59	0·56	0·53
3 200	513·0	0·69	0·68	0·67	0·66	0·65	0·64	0·63	0·62	0·60	0·58	0·55	0·52
3 300	506·0	0·68	0·67	0·66	0·65	0·64	0·62	0·62	0·61	0·59	0·57	0·54	0·51
3 400	500·0	0·67	0·66	0·65	0·64	0·63	0·62	0·61	0·60	0·58	0·56	0·53	0·51
3 500	493·0	0·66	0·65	0·64	0·63	0·62	0·60	0·60	0·59	0·57	0·55	0·52	0·49
3 600	487·0	0·65	0·64	0·63	0·62	0·61	0·60	0·59	0·58	0·56	0·54	0·51	0·49
3 700	481·0	0·64	0·63	0·62	0·61	0·60	0·59	0·58	0·57	0·55	0·53	0·51	0·48
3 800	474·0	0·63	0·62	0·61	0·60	0·59	0·58	0·57	0·56	0·54	0·52	0·50	0·47
3 900	468·0	0·62	0·61	0·60	0·59	0·58	0·57	0·56	0·55	0·53	0·51	0·49	0·46
4 000	462·0	0·61	0·60	0·59	0·58	0·57	0·56	0·55	0·54	0·52	0·50	0·48	0·45
4 100	456·0	0·60	0·59	0·58	0·57	0·56	0·55	0·54	0·53	0·51	0·49	0·47	0·44
4 200	451·0	0·59	0·59	0·58	0·56	0·55	0·54	0·53	0·52	0·51	0·49	0·46	0·43
4 300	445·0	0·58	0·58	0·57	0·56	0·54	0·53	0·52	0·52	0·50	0·48	0·45	0·42
4 400	439·0	0·57	0·57	0·56	0·55	0·53	0·52	0·52	0·51	0·49	0·47	0·44	0·42
4 500	433·0	0·57	0·56	0·55	0·54	0·53	0·51	0·51	0·50	0·48	0·46	0·43	0·41
4 600	427·0	0·56	0·55	0·54	0·53	0·52	0·50	0·50	0·49	0·47	0·45	0·43	0·40
4 700	421·0	0·55	0·54	0·53	0·52	0·51	0·49	0·49	0·48	0·46	0·44	0·42	0·39
4 800	415·0	0·54	0·53	0·52	0·51	0·50	0·49	0·48	0·47	0·45	0·43	0·41	0·38
4 900	410·0	0·53	0·52	0·51	0·50	0·49	0·48	0·47	0·46	0·44	0·42	0·40	0·37
5 000	405·0	0·52	0·51	0·50	0·49	0·48	0·47	0·46	0·45	0·44	0·42	0·39	0·37

Standard reference conditions { Mean barometric pressure = 100 kPa (750 mm of mercury)
Intake air temperature 300 K (27°C)
Relative humidity = 80 percent at 300 K

(Continued)

APPENDIX E

POWER CORRECTION ADJUSTMENT FACTOR ALPHA (α) FOR NON-TURBOCHARGED CONSTANT SPEED ENGINES THE PERFORMANCE OF WHICH IS LIMITED BY AIR EXCESS FOR 85 PERCENT MECHANICAL EFFICIENCY — *Contd*

Height Above Sea Level	Air Pressure	Temperature of Inlet Air (Celsius) at 100 Percent Relative Humidity											
m	mm-Hg	0	5	10	15	20	25	27	30	35	40	45	50
0	760·0	1·09	1·07	1·06	1·04	1·03	1·01	1·00	0·99	0·96	0·93	0·90	0·86
100	751·0	1·07	1·06	1·05	1·03	1·01	0·99	0·98	0·97	0·95	0·92	0·89	0·85
200	742·0	1·06	1·05	1·03	1·02	1·00	0·98	0·97	0·96	0 93	0·91	0·87	0·83
300	733·0	1·05	1·03	1·02	1·00	0·99	0·97	0·96	0·94	0 92	0·89	0·86	0·82
400	725·0	1·03	1·02	1·00	0·99	0·97	0·95	0·94	0·93	0·91	0·88	0·85	0·81
500	716·0	1·02	1·00	0·99	0·93	0·96	0·94	0·93	0 92	0·89	0·87	0·83	0·80
600	708·0	1·01	0·99	0·98	0·96	0·95	0·93	0·92	0·91	0·88	0·85	0·82	0·78
700	699·0	0·99	0·98	0·96	0 95	0·93	0·91	0 91	0·89	0·87	0·84	0·81	0·77
800	691·0	0·98	0·96	0 95	0·94	0·92	0·90	0·89	0·88	0·86	0·83	0·80	0·76
900	682·0	0·96	0·95	0·94	0·92	0·91	0·89	0·88	0·87	0·84	0·82	0·78	0·75
1 000	674·0	0·95	0·94	0·92	0·91	0·89	0·87	0·87	0·86	0·83	0·80	0·77	0·73
1 100	666·0	0·94	0·92	0·91	0·90	0·88	0·86	0·85	0·84	0·82	0·79	0·76	0·72
1 200	658·0	0·93	0·91	0·90	0·88	0·87	0·85	0·84	0·83	0·81	0·78	0·75	0·71
1 300	650·0	0·91	0·90	0·89	0·87	0·86	0·84	0·83	0·82	0·79	0·77	0·74	0·70
1 400	642·0	0·90	0·89	0·87	0·86	0·84	0·83	0·82	0·81	0·78	0·76	0·72	0·69
1 500	634·0	0·89	0·87	0·86	0·85	0·83	0·81	0·81	0·79	0·77	0·74	0·71	0·68
1 600	626·0	0·87	0·86	0·85	0·83	0·82	0·80	0·79	0·78	0·76	0·73	0·70	0·66
1 700	618·0	0·86	0·85	0·84	0·82	0·81	0·79	0·78	0·77	0·75	0·72	0·69	0·65
1 800	611·0	0·85	0·84	0·83	0·81	0·80	0·78	0·77	0·76	0·74	0·71	0·68	0·64
1 900	600·0	0·83	0·82	0·81	0·79	0·78	0·76	0·75	0·74	0·72	0·69	0·66	0 63
2 000	595·0	0·83	0·81	0·80	0·79	0·77	0·75	0·75	0·74	0·71	0·69	0·66	0·62
2 100	589·0	0·81	0·80	0·79	0·78	0·76	0·74	0·74	0·73	0·70	0·68	0·65	0·61
2 200	582·0	0·80	0·79	0·78	0·77	0·75	0·73	0·73	0·71	0·69	0·67	0·63	0·60
2 300	574·0	0·79	0·78	0·77	0·75	0·74	0·72	0·71	0·70	0·68	0·65	0·62	0·59
2 400	567·0	0·78	0·77	0·76	0·74	0·73	0·71	0·70	0·69	0·67	0·64	0·61	0·58
2 500	560·0	0·77	0·76	0·74	0·73	0·72	0·70	0·69	0·68	0·66	0·63	0·60	0·57
2 600	553·0	0·76	0·75	0·73	0·72	0·71	0·69	0·68	0·67	0·65	0·62	0·59	0·56
2 700	546·0	0·75	0·73	0·72	0·71	0·70	0·68	0·67	0·66	0·64	0·61	0·58	0·55
2 800	539·0	0·73	0·72	0·71	0·70	0·68	0·67	0·66	0·65	0·63	0·60	0·57	0·54
2 900	532·0	0·72	0·71	0·70	0·69	0·67	0·66	0 65	0·64	0·62	0 59	0·56	0·53
3 000	526·0	0·71	0·70	0·69	0·68	0·66	0·65	0·64	0·63	0·61	0·58	0·55	0·52
3 100	519·0	0·70	0·69	0·68	0·67	0·65	0·64	0·63	0·62	0·60	0·57	0·54	0·51
3 200	513·0	0·69	0·68	0·67	0·66	0·64	0·63	0·62	0·61	0·59	0·56	0·53	0·50
3 300	506·0	0·68	0·67	0·66	0·65	0·63	0·62	0·61	0·60	0·58	0·55	0·52	0·49
3 400	500·0	0·67	0·66	0·65	0·64	0·62	0·61	0·60	0·59	0·57	0·54	0·51	0·48
3 500	493·0	0·66	0·65	0·64	0·63	0·61	0·60	0·59	0·58	0·56	0·53	0·50	0·47
3 600	487·0	0·65	0·64	0·63	0·62	0·60	0·59	0·58	0·57	0·55	0·52	0·49	0·46
3 700	481·0	0·64	0·63	0·62	0·61	0·59	0·58	0·57	0·56	0·54	0·51	0·48	0·45
3 800	474·0	0·63	0·62	0·61	0·60	0·58	0·57	0 56	0·55	0·53	0·50	0·47	0·44
3 900	468·0	0·62	0·61	0·60	0·59	0·57	0·56	0·55	0·54	0·52	0·49	0·47	0·43
4 000	462·0	0·61	0·60	0·59	0·58	0·57	0·55	0·54	0·53	0·51	0·49	0·46	0·42
4 100	456·0	0·60	0·59	0·58	0·57	0·56	0·54	0·53	0·52	0·50	0·48	0·45	0·41
4 200	451·0	0·59	0·58	0·57	0 56	0·55	0·53	0·53	0·52	0·49	0·47	0·44	0·41
4 300	445·0	0·58	0·57	0·56	0·55	0·54	0·52	0·52	0·51	0·48	0·46	0·43	0·40
4 400	439·0	0·57	0·56	0·55	0·54	0·53	0·51	0·51	0·50	0·48	0·45	0·42	0·39
4 500	433·0	0·56	0·55	0·54	0 53	0·52	0·50	0·50	0·49	0·47	0·44	0·41	0·38
4 600	427·0	0·55	0·54	0·54	0·52	0·51	0·50	0·49	0·48	0·46	0·43	0·40	0·37
4 700	421·0	0·54	0·54	0·53	0·51	0·50	0·49	0·48	0·47	0·45	0·42	0·40	0·36
4 800	415·0	0·54	0·53	0·52	0·50	0·49	0·48	0·47	0·46	0·44	0·42	0·39	0·35
4 900	410·0	0·53	0·52	0·51	0·50	0·48	0·47	0·46	0·45	0·43	0·41	0·38	0·35
5 000	405·0	0·52	0·51	0·50	0·49	0·48	0·46	0·46	0·45	0·42	0·40	0·37	0·34

Standard reference conditions { Mean barometric pressure = 100 kPa (750 mm of mercury)
Intake air temperature 300 K (27° C)
Relative humidity = 60 percent at 300 K

APPENDIX F

(*Clauses* 3.2.2 *and* H-1.6)

DETERMINATION OF THE FUEL CONSUMPTION ADJUSTMENT FACTOR (β)

F-1. The table below gives values of the fuel consumption adjustment factor (β) for known value of the ratio of indicated power (k) and mechanical efficiency (η_m).

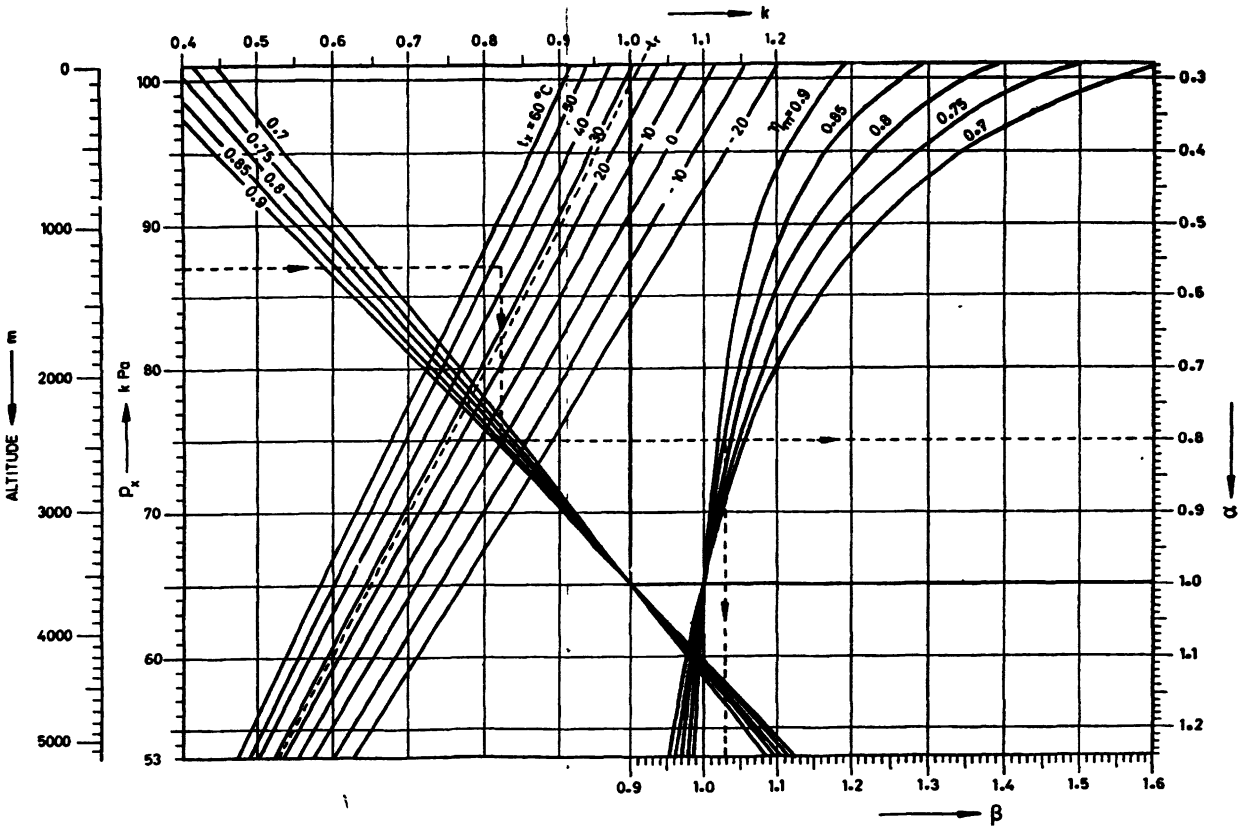
F-2. The value of k can be determined from Appendix B.

F-3. The value of η_m is stated by the manufacturer (*see* 2.3, Note 3) or determined by test (*see* 6)

k	β					
	η_m					
	0·70	0·75	0·80	0·85	0·90	0·95
0·50	1·429	1·304	1·212	1·141	1·084	1·038
0·52	1·383	1·275	1·193	1·129	1·077	1·035
0·54	1·343	1·248	1·175	1·118	1·071	1·032
0·56	1·308	1·225	1·159	1·108	1·065	1·030
0·58	1·278	1·203	1·145	1·098	1·060	1·027
0·60	1·250	1·184	1·132	1·090	1·055	1·025
0·62	1·225	1·167	1·120	1·082	1·050	1·023
0·64	1·203	1·151	1·109	1·075	1·046	1·021
0·66	1·183	1·137	1·099	1·068	1·042	1·019
0·68	1·164	1·123	1·090	1·062	1·038	1·018
0·70	1·148	1·111	1·081	1·056	1·035	1·016
0·72	1·132	1·100	1·073	1·051	1·031	1·015
0·74	1·118	1·089	1·066	1·045	1·028	1·013
0·76	1·105	1·080	1·059	1·041	1·025	1·012
0·78	1·092	1·070	1·052	1·036	1·022	1·011
0·80	1·081	1·062	1·046	1·032	1·020	1·009
0·82	1·071	1·054	1·040	1·028	1·017	1·008
0·84	1·061	1·047	1·035	1·024	1·015	1·007
0·86	1·051	1·040	1·029	1·021	1·013	1·006
0·88	1·043	1·033	1·024	1·017	1·011	1·005
0·90	1·035	1·027	1·020	1·014	1·009	1·004
0·92	1·027	1·021	1·016	1·011	1·007	1·003
0·94	1·020	1·015	1·011	1·008	1·005	1·002
0·96	1·013	1·010	1·007	1·005	1·003	1·002
0·98	1·006	1·005	1·004	1·003	1·002	1·001
1·00	1·000	1·000	1·000	1·000	1·000	1·000
1·02	0·994	0·995	0·997	0·998	0·999	0·999
1·04	0·989	0·991	0·993	0·995	0·997	0·999
1·06	0·983	0·987	0·990	0·993	0·996	0·998
1·08	0·978	0·983	0·987	0·991	0 994	0·997
1·10	0·974	0·979	0·984	0·989	0·993	0·997
1·12	0·969	0·976	0·982	0·987	0·992	0·996
1·14	0·965	0·972	0·979	0·985	0·991	0·996
1·16	0·960	0·969	0·976	0·983	0·989	0·995
1·18	0·956	0·966	0·974	0·982	0·988	0·994
1·20	0·952	0·963	0·972	0·980	0·987	0·994

FUEL CONSUMPTION ADJUSTMENT FACTOR (α) UTILISING FACTORS AND EXPONENTS IN TABLE 1 —*Contd*

FORMULA REFERENCE B



p_r	t_r	a	m	n	q
100 k Pa	27 °C	0	1	1	0

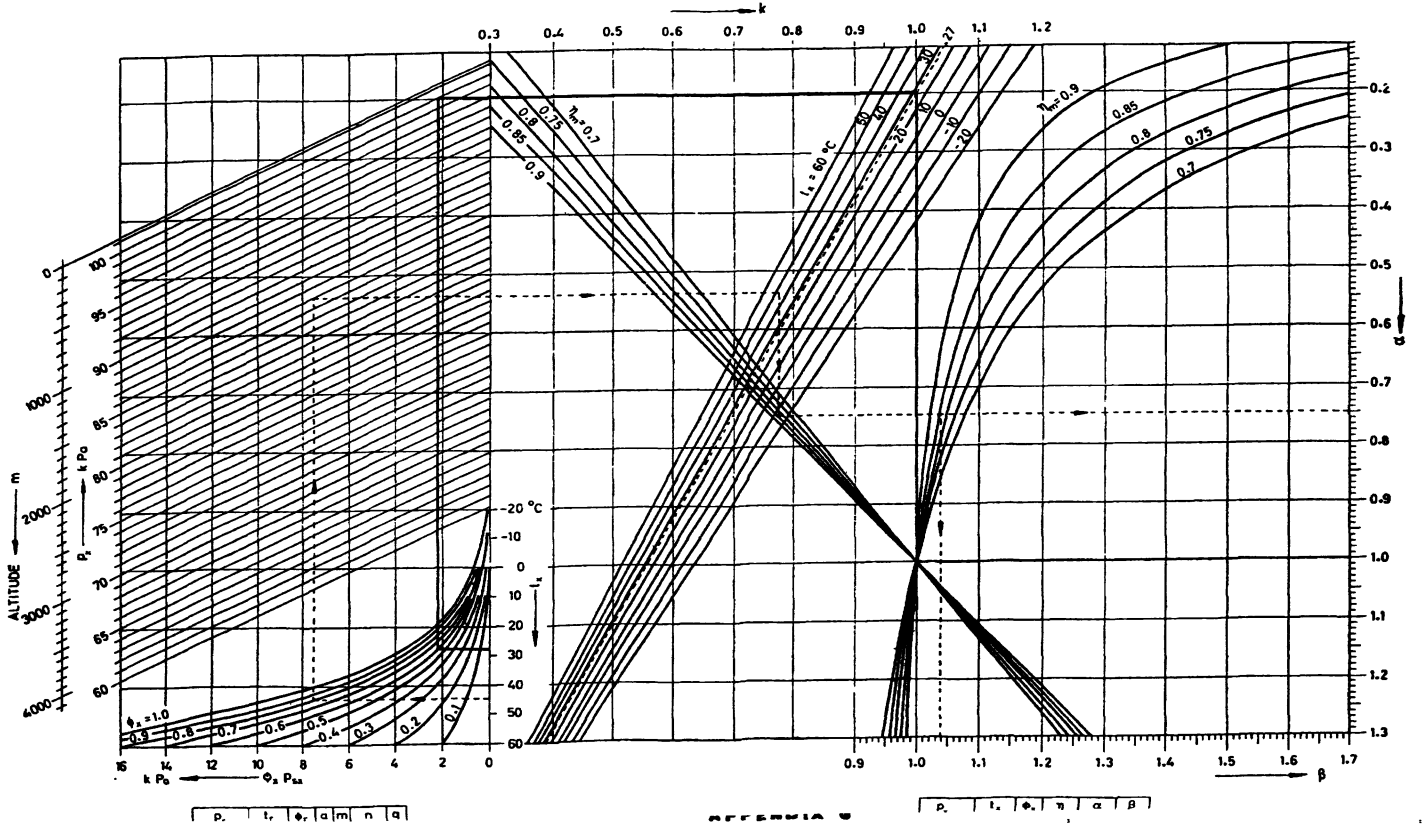
p_x	t_x	η_m	α	β
87 k Pa	45 °C	0·85	0·8	1·03

APPENDIX G

(*Clauses* 2.3.1 *and* 3.2.2)

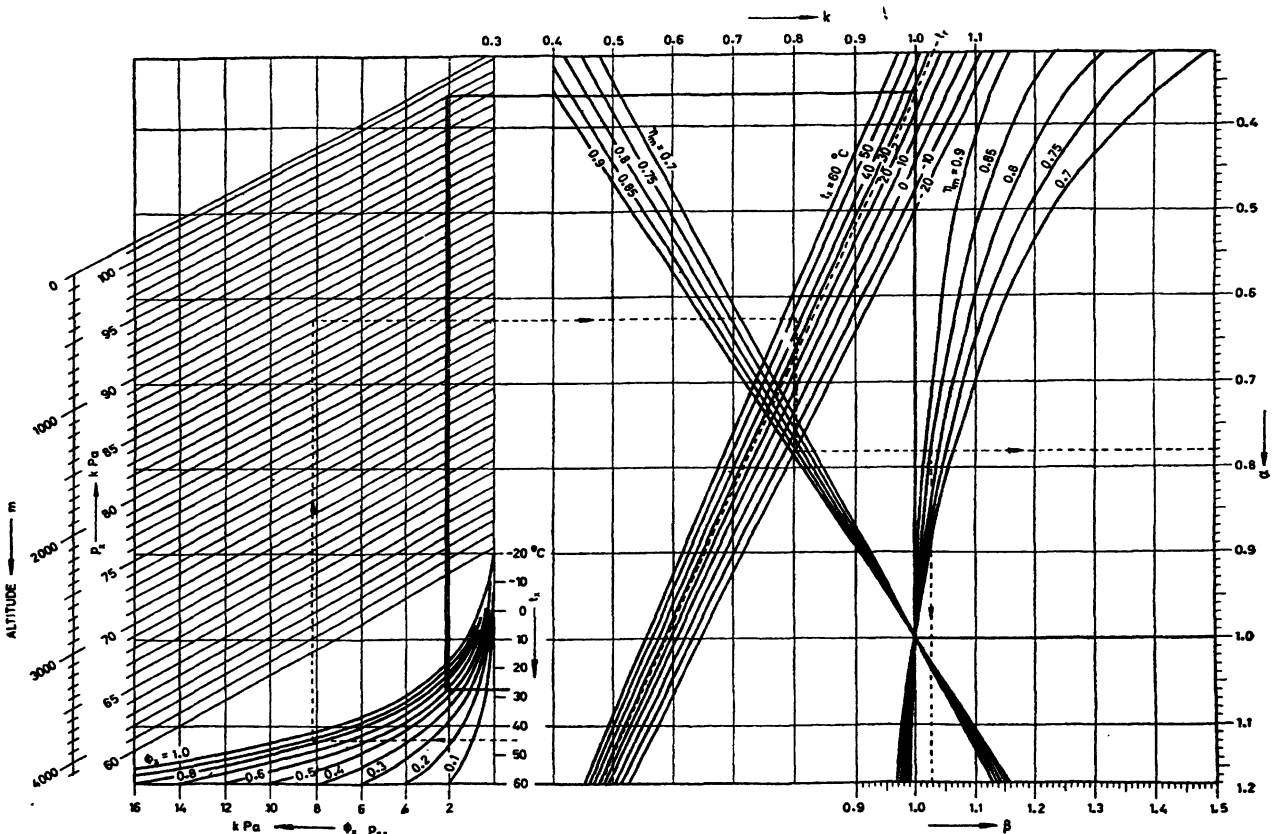
NOMOGRAM FOR CALCULATION OF POWER ADJUSTMENT FACTOR (α) AND SPECIFIC FUEL CONSUMPTION ADJUSTMENT FACTOR (β) UTILISING FACTORS AND EXPONENTS IN TABLE 1

FORMULA REFERENCE A



NOMOGRAM FOR CALCULATION OF POWER ADJUSTMENT FACTOR (α) AND SPECIFIC FUEL CONSUMPTION ADJUSTMENT FACTOR (β) UTILISING FACTORS AND EXPONENTS IN TABLE 1 — *Contd*

FORMULA REFERENCE E



P_r	t_r	ϕ_r	a	m	n	q
100 k Pa	27 °C	0.6	1	0.86	0.55	0

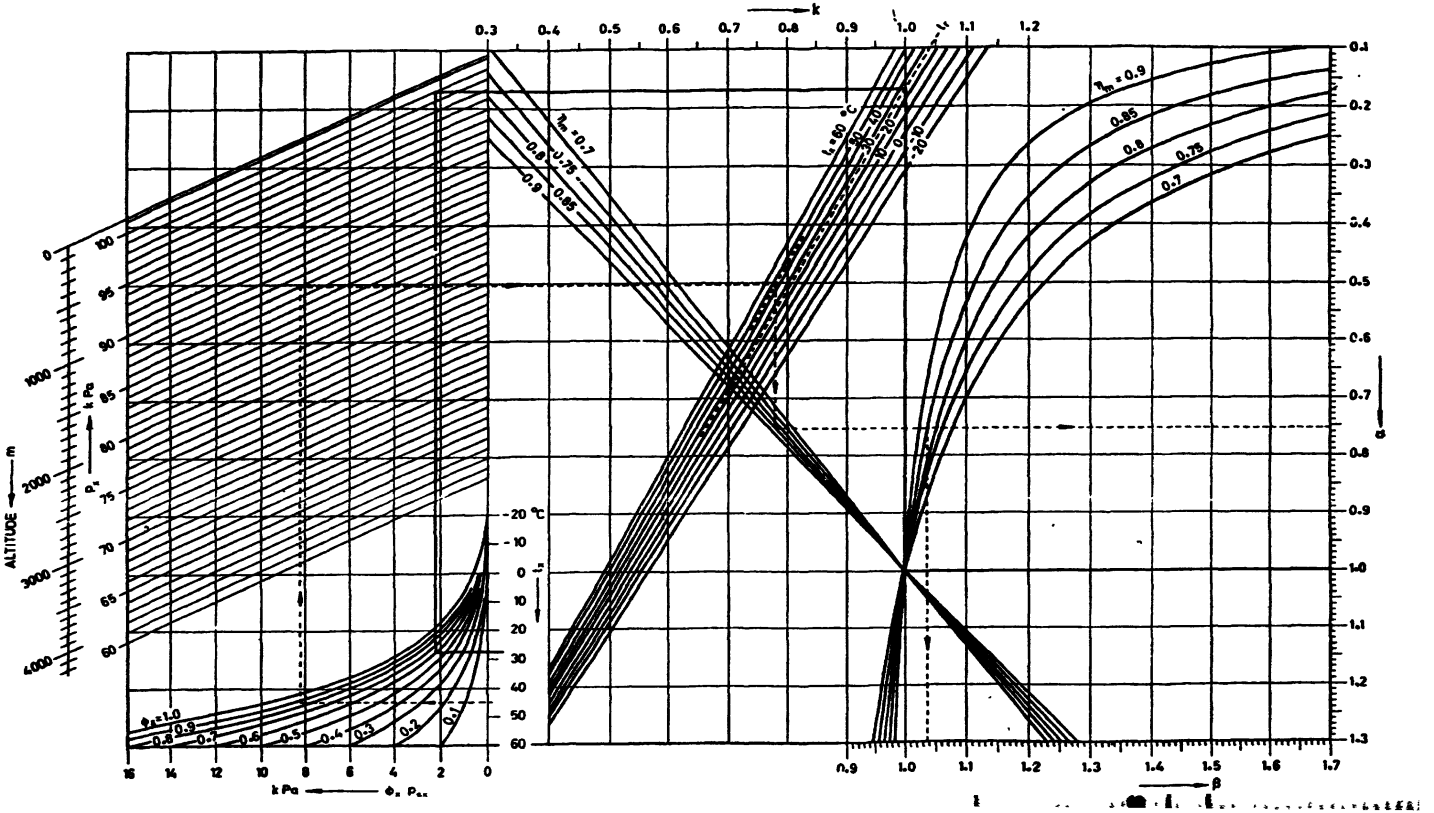
P_x	t_x	ϕ_x	η_m	α	β
87 k Pa	45 °C	0.85	0.85	0.78	1.03

(Continued)

APPENDIX G

NOMOGRAM FOR CALCULATION OF POWER ADJUSTMENT FACTOR (α) AND SPECIFIC FUEL CONSUMPTION ADJUSTMENT FACTOR (β) UTILISING FACTORS AND EXPONENTS IN TABLE 1 — *Contd*

FORMULA REFERENCE G



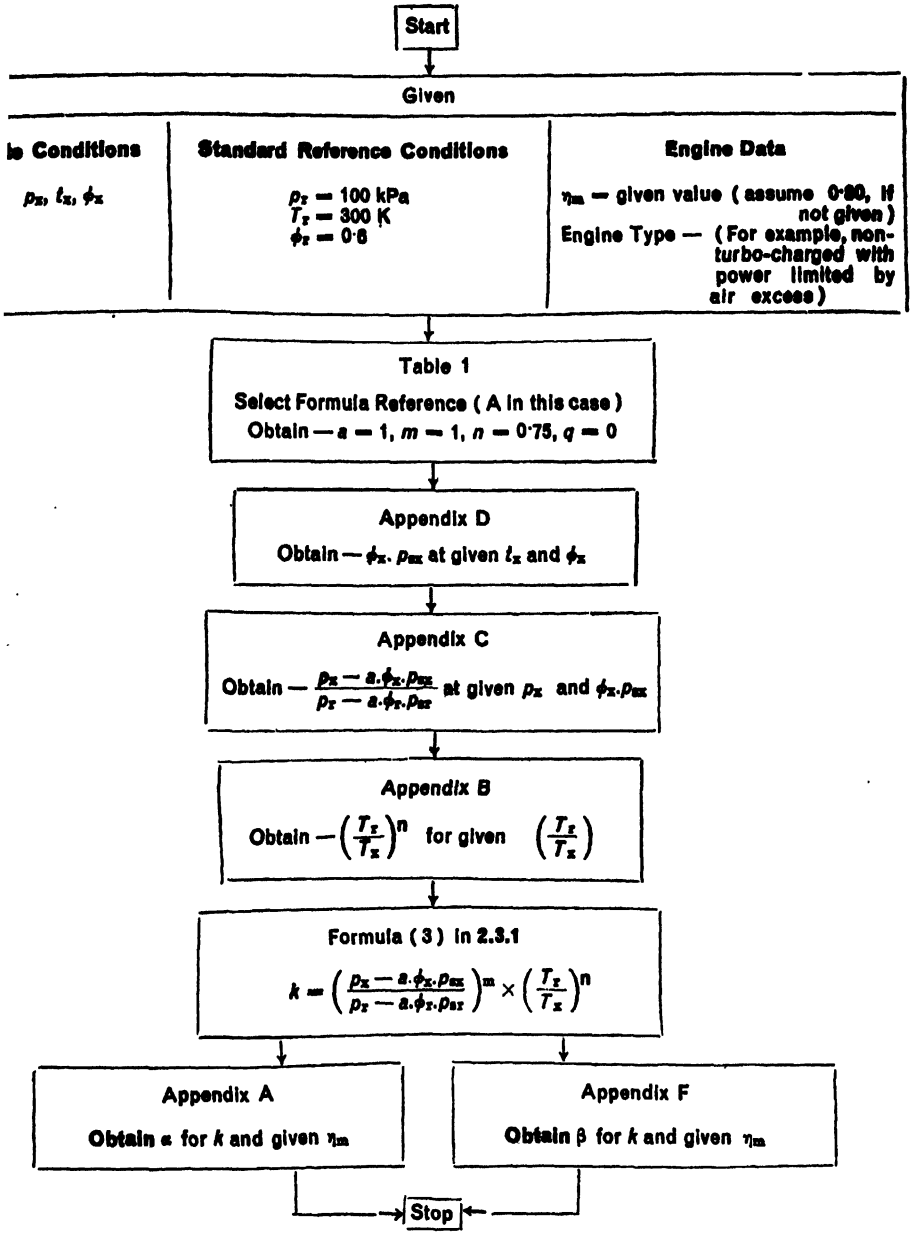


FIG. 1 FLOW CHART FOR CALCULATION OF α AND β USING TABLE 1 AND APPENDICES A, B, C, D AND F

APPENDIX H

(*Clauses* 2.3.1 *and* 3.2.2)

EXAMPLES OF CALCULATION OF POWER AND FUEL CONSUMPTION ADJUSTMENT

H-1. A non-turbocharged engine with its power limited by air excess has an IS Rating A of 500 kW with a mechanical efficiency of 85 percent, and specific fuel consumption of 220 g/kW.h.

What is the expected continuous net brake power and specific fuel consumption at a site with a total barometric pressure of 87 kPa, air temperature 45° C and relative humidity 80 percent ?

H-1.1 From Table 1, formula A gives $a = 1$, $m = 1$ and $n = 0{\cdot}75$.

Standard Reference Conditions	*Site Conditions*
$p_r = 100$ kPa	$p_x = 87$ kPa
$T_r = 300$ K	$T_x = 318$ K
$\phi_r = 0{\cdot}6$	$\phi_x = 0{\cdot}8$

and $\eta_m = 0{\cdot}85$

H-1.2 From Appendix D, at $t_x = 45°C$ and $\phi_x = 0{\cdot}8$, by interpolation

$$\phi_x . p_{sx} = 7{\cdot}7 \text{ kPa}$$

H-1.3 From Appendix C, at $p_x = 87$ kPa and $\phi_x . p_{sx} = 7{\cdot}7$ kPa, by interpolation

$$\frac{p_x - a.\phi_x . p_{sx}}{p_r - a.\phi_r . p_{sr}} = 0{\cdot}810$$

H-1.4 From Appendix B, at $\frac{T_r}{T_x} = \frac{300}{318} = 0{\cdot}943$ and $n = 0{\cdot}75$, by interpolation

$$\left(\frac{T_r}{T_x}\right)^n = 0{\cdot}957$$

H-1.5 From formula (3) in 2.3, $k = 0{\cdot}810 \times 0{\cdot}957 = 0{\cdot}775$

H-1.6 From Appendix F, at $k = 0{\cdot}775$ and $\eta_m = 0{\cdot}85$, by interpolation $\beta = 1{\cdot}038$

H-1.7 From Appendix A, at $k = 0{\cdot}775$ and $\eta_m = 0{\cdot}85$, by interpolation $\alpha = 0{\cdot}744$

H-1.8 Therefore, site continuous net brake power $= 500 \times 0{\cdot}744 = 372$ kW, and site specific fuel consumption $= 220 \times 1{\cdot}038 = 228{\cdot}4$ g/kW.h.

EXPLANATORY NOTE

The testing and performance of constant speed and variable speed internal combustion engines was earlier covered by the following Indian Standards :

IS : 1600-1960 Code for type testing of constant speed internal combustion engines for general purposes

IS : 1601-1960 Performance of constant speed internal combustion engines for general purposes

IS : 1602-1960 Code for type testing of variable speed internal combustion engines for automotive purposes

IS : 1603-1960 Performance of variable speed internal combustion engines for automotive purposes

These standards were originally issued in the year 1960. As a result of implementation of these standards by the manufacturers of engines and testing laboratories, as also the operation of ISI Certification Marking Scheme, the standards have now been extensively revised.

While IS : 1600 and IS : 1602 covered the codes for type testing of constant and variable speed engines respectively, the performance requirements of such engines were covered by IS : 1601 and

IS : 1603, respectively. These standards are replaced by two sets of standards, one set covers the methods of testing of engines and the other covers the specification and performance requirements of both constant speed and variable speed engines.

The standard covering methods of tests is being published in following 12 parts (each part covering a particular test method or information related to methods of tests) :

IS : 10000 Methods of tests for internal combustion engines

Part I Glossary of terms relating to test methods

Part II Standard reference conditions

Part III Measurements for testing, units and limits of accuracy

Part IV Declarations of power, efficiency, fuel consumption and lubricating oil consumption

Part V Preparation for tests and measurements for wear

Part VI Recording of test results

Part VII Governing tests for constant speed engines and selection of engines for use with electrical generators

Part VIII Performance tests

Part IX Endurance tests

Part X Tests for smoke levels, limits and corrections for smoke levels for variable speed engines

Part XI Information required with inquiry or order and information supplied by the manufacturer with the engine

Part XII Test certificates

This standard will be complementary to specifications for performance requirements of different types of engines covered by following standards :

IS : 10001 Specification for performance requirements for constant speed compression ignition (diesel) engines for general purposes (up to 20 kW)

IS : 10002 Specification for performance requirements for constant speed compression ignition (diesel) engines for general purposes (above 20 kW)

IS : 10003 Specification for performance requirements for variable speed compression ignition (diesel) engines for automotive purposes

IS : 10004 Specification for performance requirements for variable speed spark ignition engines for automotive purposes

Spark ignition engines for sprayers and similar applications have been covered by IS : 7347-1974 'Specification for performance requirements of small size spark ignition engines for sprayers'.

Two-stroke spark ignition engines for automotive applications which were earlier covered by IS : 1603 will be covered by a separate specification.

The revised methods of tests covered by IS : 10000 have been aligned with the current international practices in the field of internal combustion engines. These parts are in general agreement with the following ISO standards issued by the International Organization for Standardization :

ISO 3046/I-1975 Reciprocating internal combustion engines — Performance : Part I Standard reference conditions and declarations of power, fuel consumption and lubricating oil consumption

ISO 3046/II-1977 Reciprocating internal combustion engines — Performance : Part II Test methods

ISO 3046/III-1979 Reciprocating internal combustion engines — Performance : Part III Test measurements

ISO 2710-1978 Reciprocating internal combustion engines — Vocabulary

Section I of this standard (applicable for general purpose engines) is in agreement with ISO 3046/I-1975. However, additional Appendices pertaining to calculation of power adjustment factor 'α', specific fuel consumption adjustment factor 'β', ratio of indicated power 'k', dry air pressure ratio, and water vapour pressure have been included to reflect the present international thinking in the field. An Appendix on the example of calculation of power and specific fuel consumption adjustment has also been included. The nomograms to facilitate calculation of 'α' and 'β' are

printed in bigger sizes for ease in reference and interpolation: The table for exponents and factors for calculation of 'α' and 'β' presently covers only a limited type of engines and will be enlarged at a later date to cover additional types of engines.

Section II of this standard [applicable for variable speed (automotive) engines] has correction formula similar to ISO 1585-1974, but is based on standard reference conditions different from those given in ISO 1585-1974 [*see* IS : 10000 (Part II) - 1980]. It also envisages correction for difference in calorific value of fuel, if the test fuel is different from the reference fuel.

Turbo-charged engines and turbo-charged engines with charge air cooling have not been covered by this standard and will be covered by a separate standard.

IS : 10000 (Part I to XII) - 1980 and IS : 10001, IS : 10002, IS : 10003 and IS : 10004 collectively supersede IS : 1600, IS : 1601, IS : 1602 and IS : 1603.

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TO

IS : 10000 (Part IV)-1980 METHODS OF TESTS FOR INTERNAL COMBUSTION ENGINES

PART IV DECLARATION OF POWER, EFFICIENCY, FUEL CONSUMPTION AND LUBRICATING OIL CONSUMPTION

(*Page* 3, *clause* **3.1**) — Substitute the following for the existing clause:

'**3.1** A tolerance of +5 percent in fuel consumption at 100 percent of the rated load shall be allowed.'

(*Page* 3, *clause* **3.2.3** *and Note under it*) — Substitute the following for the existing:

'**3.2.3** *Adjustment for calorific value of fuel for liquid fuel engines* — In case the liquid fuel engines use fuel different from the fuel with a lower calorific value of 42 000 kJ/kg, a correction for the difference in calorific value given by the following formula shall be applied:

$$\beta_{cv} = \frac{C\,V}{42\,000} \text{ and}$$

Adjusted specific fuel consumption

$= \beta_{cv}$ x calculated specific fuel consumption

where

β_{cv} = specific fuel consumption adjustment factor for calorific value of fuel; and

$C\,V$ = net lower calorific value of fuel used, kJ/kg.

NOTE — The specific fuel consumption of a liquid fuel (diesel) engine is related to a reference lower calorific value of 42 000 kJ/kg. For other fuels the calorific value shall be determined in accordance with **3.2.3.1**.'

(*Page* 3, *clause* **3.2.3**) — Add the following new clause after **3.2.3**:

'**3.2.3.1** The calorific value of fuel for liquid fuels may be determined in accordance with IS : 1448 [P : 6]-1960 'Methods of tests for petroleum and its products: Part 6 Calorific value by bomb calorimeter method'. Alternatively it may be calculated as per IS : 1448 [P : 7]-1960 'Methods of tests for petroleum and its products: Part 7 Calorific value by calculation.'

(*Page* 4, *clause* 6, *second sentence*) — Substitute the following sentence for the existing:

' Alternatively, it may be calculated by using the indicated power from the indicator diagram or by using Willan's line method. '

(*Page* 4, *clause* 7.3.1, *Title*) — Substitute ' Power adjustment factor 'a' *for* ' Power correction factor 'a'.

(*Page* 4, *clause* 7.3.1.1) Substitute the following formula for the existing:

$$' a = \left(\frac{p}{100}\right)^{0.65} \times \left(\frac{300}{T}\right)^{0.5} '$$

(*Page* 5, *clause* 7.3.1.1.1) — Substitute the formula $' a = 1 - \frac{A}{100} '$ *for* $' a = 1 + \frac{A}{100} '$.

(*Page* 5, *clause* 7.3.1.2) — Substitute the following formula for the existing:

$$' a = \left(\frac{p}{100}\right) \left(\frac{300}{T}\right)^{0.5} '$$

(*Page* 5, *clause* 8.1) — Substitute the following for the existing clause:

' **8.1** A tolerance of +5 percent in fuel consumption at 100 percent of the rated load throughout the speed range shall be allowed. '

(*Page* 5, *clause* 8.2.2 *and Note under it*) — Substitute the following for the existing:

' **8.2.2** *Adjustment for calorific value for liquid fuel* — It shall be applied when there is a difference in the net calorific value of the test fuel and that of fuel specified in Section II of IS : 10000 (Part 2)-1980. The factor is given by the following formula:

$$\beta_{cv} = \frac{CV}{42\,000}$$

where

β_{cv} and CV have the same connotation as in **3.2.3.**

NOTE — The specific fuel consumption of a liquid fuel (diesel) engine is related to a reference lower calorific value of 42 000 kJ/kg. For other fuels the calorific value shall be determined in accordance with **3.2.3.1.**'

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